

NATIONALGEOGRAPHIC.COM/MAGAZINE


OCTOBER 2004

NATIONAL GEOGRAPHIC

Red Hot Hawaii



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Lava escapes from Pu'u
'Ō'ō vent in Hawai'i
Volcanoes National Park.
BY FRANS LANTING

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ON THE WEBSITE

nationalgeographic.com/magazine
SIGHTS & SOUNDS Experience the cold world of the arctic fox.
VIDEO Indians of the Sierra Nevada record their culture.
DESKTOP WALLPAPER Decorate with images of Hawai'i's fiery Kīlauea volcano.

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OnScreen & Online

National Geographic Channel

WEDNESDAYS, 10 P.M.
ET/PT

Naked Science

Sweeping aside veils of myth and misunderstanding, a bold new series uses fresh findings and dramatic reconstructions to investigate some of our most compelling scientific mysteries. Could an immense volcanic eruption in Yellowstone National Park alter the climate and lead to widespread death? Is life possible on a recently discovered planet? How was the enigmatic Stonehenge (above) constructed, and are the human remains buried nearby those of its builders? How vulnerable is Earth to an asteroid strike? And what would that catastrophic collision look like? *Naked Science* lays bare some surprising answers.



WEDNESDAYS, 9 P.M. ET/PT

MegaStructures When size matters—as with the 110-story Sears Tower in Chicago, or a warship with 6,000 men and women aboard, or the 31-mile-long English Channel Tunnel (left)—the biggest concern is how to keep things running smoothly. A new series delves into the daily efforts behind the success of megastructures.



VISIT NATIONALGEOGRAPHIC.COM/CHANNEL TO FIND OUT WHAT'S ON—AND HOW TO GET THE CHANNEL IN YOUR AREA

SUNDAY, OCT. 24
8 P.M. ET/PT

Inside the U.S. Secret Service

Go on duty with the men and women of the Secret Service. Rare access reveals how they work events to protect the life of the President.

Channel and NGT&F programming information accurate at press time; consult local listings or the Society's website at nationalgeographic.com

NG Television & Film

NATIONAL GEOGRAPHIC SPECIAL, PBS, OCT. 20, 8 P.M. ET

Quest for the Phoenicians Before the Greeks and the Romans dominated the Mediterranean, the Phoenicians ruled its sea lanes. But they left behind little besides scattered artifacts such as this vivid mask (right). An hour-long special documents the search for the legacy of this obscure civilization. Explorer Robert Ballard combs the sea bottom for Phoenician wrecks from 3,000 years ago, while in Lebanon geneticist Spencer Wells hunts for links between people, ancient and modern.



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INDIGENOUS FILMMAKERS

INTERVIEW AND VIDEO Listen to photographer Stephen Ferry describe his two weeks' teaching videography to Colombia's Sierra Nevada Indians, then see the results as the new filmmakers set out to record their daily life and culture. nationalgeographic.com/magazine/0410

PHOTO OF THE DAY

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Behind the Scenes

EXPEDITION

Over Africa

He's at it again. Intrepid conservationist Mike Fay (right) last walked 2,000 miles to document and help preserve the diversity of life in Congo and Gabon. Now he's set his sights on a bigger target: all of Africa. The goal is to travel to all key ecoregions by plane and foot, discover where wild Africa survives, then spark action for conservation. His track record for protecting natural treasures is impressive. Mike's Megatransect walk across Africa led to the creation of Gabon's first system of national parks. Now, with support from National Geographic and the Wildlife Conservation Society (WCS), Mike and pilot, Peter Ragg, will spend more than a year hopscotching the continent in a two-seater Cessna from South Africa to the Sahara guided by WCS's data-rich maps, which reveal the impact of human activity. We'll track this Megaflyover with regularly updated dispatches, photographs, video, and maps on nationalgeographic.com/magazine/megaflyover. Also available there: WCS "Human Footprint" maps, lesson plans for teachers, and archived Megatransect materials. Aerial photographs from the Megaflyover will appear in an upcoming issue.



BOOK RELEASE

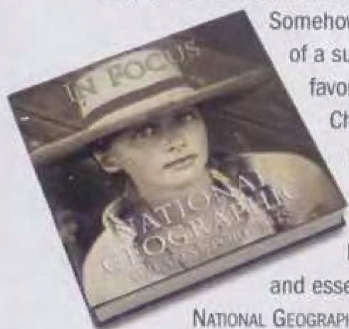
Focusing on Portraits

"Our photographers have always photographed people with the aim of understanding cultures, not individuals," says book editor Leah Bendavid-Val.

Somehow gifted shooters also manage to capture more than just an image of a subject. After looking at thousands of portraits, Leah gathered 280 favorites for a new book, *In Focus: National Geographic Greatest Portraits*.

Choosing wasn't easy. "Over the past century it seems like our photographers have taken more pictures of people than of anything else," she says. Portraits of a Parisian river cruise (below left), an Aboriginal youth in Australia, and a girl from a Nevada cattle ranch on the book's cover (left) hint at people's characters. "To capture the spirit and essence of other human beings is a challenge beyond measure," writes

NATIONAL GEOGRAPHIC Associate Editor Chris Johns in the book's foreword. "But when it happens, and the photograph comes together, the creation brings joy." Find *In Focus: National Geographic Greatest Portraits* online at shopng.com or wherever books are sold.



NGS Calendar

October

Forces of Nature opens in giant-screen theaters in Cincinnati, Ohio; Columbus, Ohio; Harrisburg, Pa.; Portland, Oreg.; Providence, R.I.; Sioux Falls, S. Dak.; Victoria, British Columbia.

2 In Focus exhibit opening. See images from the book at the Smithsonian's Museum of Natural History, Washington, D.C. (through Jan. 2).

4 In Focus book signing and presentation with photographer **Bill Allard** at Bound to be Read bookstore, St. Paul, Minn.; Allard presentation and signing at University Book Store, University of Washington, Seattle, Wash., on Oct. 7.

6 National Geographic Channel fall lineup Wednesdays: *MegaStructures* at 9 p.m. ET/PT; *Naked Science* at 10 p.m. ET/PT. Thursdays: *Air Emergency* at 8 p.m. ET/PT

6 "Passages: Photographs in Africa by **Carol Beckwith and Angela Fisher**" exhibit opening. See images of African rites of passage at National Geographic, Washington, D.C.

8 Anna Quindlen lectures about her book *Imagined London: A Tour of the World's Greatest Fictional City*, part of the NG Directions Series published by National Geographic Books, at National Geographic, Washington, D.C.; Quindlen appearance at the National Book Festival, National Mall, Washington, D.C., on Oct. 9.



ARTS

Film Festival Introduces New Voices

Two couples walk into a bar but leave three kids in the car while they're gone. It's the plot of "Two Cars, One Night" (above), a short film from New Zealand by Maori director Taika Waititi—and part of National Geographic's new All Roads Film Project. The initiative finds, showcases, and funds work of minority-culture and indigenous filmmakers struggling to enter mainstream media. Cliff Curtis is an All Roads participant and starred in the film *Whale Rider*. Says Cliff, "It's important for us to participate fully, including ownership of our images, not just as employees and cultural advisers." Find out more at nationalgeographic.com/allroads.

SPECIAL EDITION PRINT OFFER

Winter Wear

The lush coat of the arctic fox does more than keep it warm in frigid temperatures. It also helps protect the species from becoming a polar bear's snack. Foxes often trail the mighty bears, hoping for leftovers from a kill. Their thick white fur—a seasonal color change from warmer weather's brown and cream—makes it harder for the bears to find them in snow-covered surroundings.

The print is available for \$29.95 plus \$6.95 for shipping (\$9.95 for international orders). Please add appropriate sales tax for orders sent to CA, DC, FL, KY, MI, PA, VA, VT, and Canada. We will produce only as many 20-by-24-inch prints as we receive orders for by midnight on October 31, 2004. Each will be hand-numbered and embossed with the Society seal. Shipping is scheduled for early December. Call toll-free: 1-888-647-6733 (outside the U.S. and Canada call 1-515-362-3353) or order online at nationalgeographic.com/magazine.



PHOENICIANS (PAGE 26)

Get More

To learn more about a subject covered in this issue, try these National Geographic Society products and services. Call 1-888-225-5647 or go to nationalgeographic.com for more information. ■ **Quest for the Phoenicians** National Geographic Television Special on PBS, October 20, 8 p.m. ET/PT. Explorer Robert Ballard and geneticist Spencer Wells reveal secrets of Phoenician ancestry. ■ **Mystery of the Ancient Seafarers: Early Maritime Civilizations** Bob Ballard's new book combines ancient history and present-day underwater archaeology to shed light on the Phoenicians and other seafaring civilizations (\$35).

October

12 In Focus book signing and presentation by photographer Robb Kendrick at Book Passage, Corte Madera, Calif.; Kendrick presentation and signing at Boulder Book Store, Boulder, Colo., on Oct. 13; at Borders in Dallas, Tex., on Oct. 14

13 Mountain climber Mark Synnott lectures about three of his memorable ascents, including one in Guyana, at National Geographic, Washington, D.C.

22-24 All Roads Film Festival at the Egyptian Theatre, Los Angeles, Calif.

28 "Mapping With Paper and Pixel" exhibit opening. Explore the richness of modern mapping technology. National Geographic, Washington, D.C.

28-30 All Roads Film Festival, National Geographic, Washington, D.C.

November

17 National Geographic Maps Chief Cartographer Allen Carroll and map technology expert John Calkins lecture about the vision and research behind the making of the new *National Geographic Atlas of the World*. National Geographic, Washington, D.C.

18 Explorer Helen Thayer lectures about her book *Three Among the Wolves* at National Geographic, Washington, D.C.

19 Universe of Dreams Images from the Hubble Space Telescope and music of Ensemble Galilei are narrated by NPR host Neal Conan. Celebrate poems and stories about the universe at National Geographic, Washington, D.C.

Calendar dates accurate at press time; go to nationalgeographic.com or call 1-800-NGS-LINE (647-5463) for more information

THROUGH A PHOTOGRAPHER'S EYES

Visions of Earth





CANARY ISLANDS, SPAIN

At the end of the day we flew over this vineyard on the island of Lanzarote, where curved stone walls buffer the grapevines from trade winds. The helicopter was almost out of fuel, and the pilot was very nervous. But the light had turned the walls golden against the black earth below, and I had to shoot—quickly. A photographer is a witness to the art that is the Earth. What I try to do is make a record of that art, so that others can see what I have seen. —Yann Arthus-Bertrand

► Decorate your desktop with this image from the Canary Islands at nationalgeographic.com/magazine/0410.

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WILLIAM L. ALLEN

Any birth generates excitement and awe, and the birth of a volcano is no exception. In January 1983 I had the good fortune to be on the island of Hawai'i as the Kilauea volcano sprang to life and began what has become the longest ongoing eruption on the planet (above).

Two days after the eruption started, a helicopter dropped me into a U.S. Geological Survey campsite just a few hundred yards from the erupting vent. My senses were filled with the spectacular sight of molten rock blasting into the air, a river of lava flowing past, the heavy smell of sulfur dioxide, and a roar like a jet engine's. I spent that day and night photographing the Earth as it came alive. About two in the morning I joined a USGS team heading off to collect gas samples near the vent. Our route led us over razor-sharp lava, which sliced into my boots. One of the team described the path through a doomed rain forest as "the worst surface on the planet." Returning to camp, we walked along the edge of the still cooling lava. That finished off my boots.

Twenty-one years later staff writer Jennifer Holland had her boots shredded by the lava too, and photographer Frans Lanting captured the volcano's magic far better than I ever could. Turn to page 2 to see their story on Hawai'i Volcanoes National Park and the Hawaiian goddess Pele, who once gave me the unforgettable chance to see a volcano being born.

Bill Allen

0%), nausea (2% vs 3%), diarrhea (1% vs 0%), and myalgia (1% vs 2%). In long-term clinical trials, events seen in zolpidem patients (n=152) at an incidence of 1% or greater compared to placebo (n=161) were: dry mouth (3% vs 1% for placebo), allergy (4% vs 1%), back pain (3% vs 2%), influenza-like symptoms (2% vs 0%), chest pain (1% vs 0%), fatigue (1% vs 2%), palpitation (2% vs 0%), headache (19% vs 22%), drowsiness (8% vs 5%), dizziness (5% vs 1%), lethargy (3% vs 1%), drugged feeling (3% vs 0%), lightheadedness (2% vs 1%), depression (2% vs 1%), abnormal dreams (1% vs 0%), amnesia (1% vs 0%), anxiety (1% vs 1%), nervousness (1% vs 3%), sleep disorder (1% vs 0%), nausea (6% vs 6%), dyspepsia (5% vs 6%), diarrhea (3% vs 2%), abdominal pain (2% vs 2%), constipation (2% vs 1%), anorexia (1% vs 1%), vomiting (1% vs 1%), infection (1% vs 1%), myalgia (7% vs 7%), arthralgia (4% vs 4%), upper respiratory infection (5% vs 6%), sinusitis (4% vs 2%), pharyngitis (3% vs 1%), rhinitis (1% vs 3%), rash (2% vs 1%), and urinary tract infection (2% vs 2%).

Dose relationship for adverse events: There is evidence from dose comparison trials suggesting a dose relationship for many of the adverse events associated with zolpidem use, particularly for certain CNS and gastrointestinal adverse events.

Adverse events are further classified and enumerated in order of decreasing frequency using the following definitions: frequent adverse events are defined as those occurring in greater than 1/100 subjects; infrequent adverse events are those occurring in 1/100 to 1/1,000 patients; rare events are those occurring in less than 1/1,000 patients.

Frequent: abdominal pain, abnormal dreams, allergy, amnesia, anorexia, anxiety, arthralgia, asthenia, ataxia, back pain, chest pain, confusion, constipation, depression, diarrhea, diplopia, dizziness, drowsiness, drugged feeling, dry mouth, dyspepsia, euphoria, fatigue, headache, hiccup, infection, influenza-like symptoms, insomnia, lethargy, lightheadedness, myalgia, nausea, nervousness, palpitation, sleep disorder, vertigo, vision abnormal, vomiting.

Infrequent: abnormal hepatic function, agitation, arthritis, bronchitis, cerebrovascular disorder, coughing, cystitis, decreased cognition, detached, difficulty concentrating, dysarthria, dysphagia, dyspnea, edema, emotional lability, eye irritation, eye pain, falling, fever, flatulence, gastroenteritis, hallucination, hyperglycemia, hypertension, hypoesthesia, illusion, increased SGPT, increased sweating, leg cramps, malaise, menstrual disorder, migraine, pallor, paresthesia, postural hypotension, pruritus, scleritis, sleeping (after daytime dosing), speech disorder, stupor, syncope, tachycardia, taste perversion, thirst, tinnitus, trauma, tremor, urinary incontinence, vaginitis.

Rare: abdominal body sensation, abnormal accommodation, abnormal gait, abnormal thinking, abscess, acne, acute renal failure, aggressive reaction, allergic reaction, allergy aggravated, altered saliva, anaphylactic shock, anemia, angina pectoris, apathy, appetite increased, arrhythmia, arteritis, arthrosis, bilirubinemia, breast fibroadenosis, breast neoplasm, breast pain, bronchospasm, bullous eruption, circulatory failure, conjunctivitis, corneal ulceration, decreased libido, delusion, dementia, depersonalization, dermatitis, dysphasia, dysuria, enteritis, epistaxis, eructation, esophagospasm, extrasystoles, face edema, feeling strange, flushing, furunculosis, gastritis, glaucoma, gout, hemorrhoids, herpes simplex, herpes zoster, hot flashes, hypercholesterolemia, hyperhemoglobinemia, hyperlipidemia, hypertension aggravated, hypokinesia, hypotension, hypotonia, hypoxia, hysteria, impotence, increased alkaline phosphatase, increased BUN, increased ESR, increased saliva, increased SGOT, injection-site inflammation, intestinal obstruction, intoxicated feeling, lacrimation abnormal, laryngitis, leukopenia, lymphadenopathy, macrocytic anemia, manic reaction, micturition frequency, muscle weakness, myocardial infarction, neuralgia, neuritis, neuropathy, neurosis, nocturia, otitis externa, otitis media, pain, panic attacks, paresis, parosmia, periorbital edema, personality disorder, phlebitis, photopsia, photosensitivity reaction, pneumonia, polyuria, pulmonary edema, pulmonary embolism, purpura, pyelonephritis, rectal hemorrhage, renal pain, restless legs, rigors, sciatica, somnambulism, suicide attempts, tendinitis, tenesmus, tetany, thrombosis, tolerance increased, tooth caries, urinary retention, urticaria, varicose veins, ventricular tachycardia, weight decrease, yawning.

DRUG ABUSE AND DEPENDENCE

Controlled substance: Schedule IV.

Abuse and dependence: Studies of abuse potential in former drug abusers found that the effects of single doses of zolpidem tartrate 40 mg were similar, but not identical, to diazepam 20 mg, while zolpidem tartrate 10 mg was difficult to distinguish from placebo.

Sedative/hypnotics have produced withdrawal signs and symptoms following abrupt discontinuation. These reported symptoms range from mild dysphoria and insomnia to a withdrawal syndrome that may include abdominal and muscle cramps, vomiting, sweating, tremors, and convulsions. The U.S. clinical trial experience from zolpidem does not reveal any clear evidence for withdrawal syndrome. Nevertheless, the following adverse events included in DSM-III-R criteria for uncomplicated sedative/hypnotic withdrawal were reported at an incidence of <1% during U.S. clinical trials following placebo substitution occurring within 48 hours following last zolpidem treatment: fatigue, nausea, flushing, lightheadedness, uncontrolled crying, emesis, stomach cramps, panic attack, nervousness, and abdominal discomfort. Rare post-marketing reports of abuse, dependence and withdrawal have been received.

Individuals with a history of addiction to, or abuse of, drugs or alcohol are at increased risk of habituation and dependence; they should be under careful surveillance when receiving any hypnotic.

OVERDOSAGE

Signs and symptoms: In European postmarketing reports of overdose with zolpidem alone, impairment of consciousness has ranged from somnolence to light coma, with one case each of cardiovascular and respiratory compromise. Individuals have fully recovered from zolpidem tartrate overdoses up to 400 mg (40 times the maximum recommended dose). Overdose cases involving multiple CNS-depressant agents, including zolpidem, have resulted in more severe symptomatology, including fatal outcomes.

Recommended treatment: General symptomatic and supportive measures should be used along with immediate gastric lavage where appropriate. Intravenous fluids should be administered as needed. Flumazenil may be useful. Respiration, pulse, blood pressure, and other appropriate signs should be monitored and general supportive measures employed. Sedating drugs should be withheld following zolpidem overdose. Zolpidem is not dialyzable.

The possibility of multiple drug ingestion should be considered.

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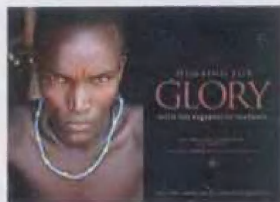
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THE ARMY OF COMPASSION

Revisiting the Elephant Hunters of Tanzania



We let you down. In the July 2004 issue we published a story about elephant hunting by the Barabaig people in Tanzania. Soon after, a few of you pointed out that there are letters and numbers on the tusk shown on page 78—faint but unmistakable in the printed magazine, yet not visible in the prints we used while preparing the article.

We now know that the photographer, Gilles Nicolet, borrowed the tusks from the Tanzania Department of Wildlife and gave them to the hunters to hold. They are not, as the picture caption says, tusks taken by the Barabaig “from an elephant found dead in the bush.” The caption was based on information provided us by Nicolet—information that he insisted was true under tough questioning from us, until after the story was published and we confronted him about the numbers. What he did, by setting up this picture, is completely contrary to how we operate at NATIONAL GEOGRAPHIC. We later learned that the two photographs on page 85—which the caption identifies as showing a hunter reclaiming his spear from an elephant and then removing the tusks—were actually taken several years earlier in Cameroon.

As soon as we learned the facts about the three pictures in early July, I put a notice on our website so that we could alert you. Why didn't we catch Nicolet's lies before the pictures were published? On rare occasions we can't get independent verification of the circumstances in which a photograph is made. This story was one of those cases, and we published it knowing that we were relying heavily on Nicolet to tell us the truth about his pictures. By not doing so, he violated his legal contract with us. We, in turn, unwittingly violated our unwritten contract with you, the reader, about the accuracy and honesty you've come to expect in NATIONAL GEOGRAPHIC photographs and text. Our editors, writers, and researchers tried their best to confirm Nicolet's account before publication. But I'm still losing sleep over the fact that we failed to uncover the truth before publishing the pictures.

As Editor, nothing is more important to me than the bond of trust between this magazine and you. We have thoroughly reviewed our procedures to ensure that this kind of thing doesn't happen again. You have our apology.

—Bill Allen

Forum



June 2004

"The End of Cheap Oil" elicited the most mail this month—in fact it provoked the second largest number of letters we've received on any story this year (first place goes to March's "The Rebirth of Armenia"). Many readers said they were outraged by a quote on pages 86-7 by the owner of a Hummer in Georgia, who said, "I know it's not fuel efficient, but I love knowing that anything I bump into, I win."

The End of Cheap Oil

I must take serious exception to your chart "The Real Cost of Gasoline." Like many, you have missed the elephant sitting in the front hall—the billions of extra dollars being spent each year for the war in Iraq.

ROBERT STANFIELD
Pipersville, Pennsylvania

It's about time Americans realize how spoiled they have been, being able to buy gasoline so cheaply for so long. As I write this, the price of gas is roughly two dollars per gallon—about half of what much of the rest of the world pays. Maybe this will trigger a real start in the research for more alternatives to fossil fuels, a final weaning from oil, and a sense of community where people carpool and share.

ALBY THOUMSIN
Springfield, Oregon

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I greeted your headline "The End of Cheap Oil" with a wry smile. We haven't seen cheap oil in the U.K. for years. With prices approaching one British pound [\$1.82] per liter [0.264 gallons], we know that a fair proportion of this is "carbon tax" to discourage carbon dioxide emissions. When will the U.S. swallow the bitter pill and follow suit?

ERIC FRANKLIN
Bromham, Wiltshire

I was very disappointed to see NATIONAL GEOGRAPHIC take an overtly political position. Environmental alarmists have promised disaster right around the corner for decades—from Paul Ehrlich, author of *The Population Bomb*, who predicted worldwide food riots in the 1980s, to warnings in the first oil crisis that the world would run out of oil by the year 2000. What these gloom-and-doom predictions never consider are the miracles of technological innovation and man's almost limitless adaptability.

PHIL RICHARDSON
Annandale, Virginia

The sad reality is that Americans have the research and technological ability to develop an alternative fuel and thus end their



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Geographica: Embedded Memories

It was wonderful to read about Gunter Demnig, the man who set up the *stolpersteine* project [metal sidewalk plaques commemorating Holocaust victims]. He is forcing Germany to always remember the Holocaust. Those who are against the plaques are afraid to face the reality of what once happened at their very doorstep.

PATRICIA DESALES
Caledon, Ontario

It is a fitting reminder to post plaques near the places those people used to live, but I am skeptical about their placement in the sidewalk. They will be covered in muck and practically invisible during the European winters. What may be suitable for the star-studded



HEINER MÜLLER-ELSNER

sidewalk in Hollywood is improper for these plaques.

PAUL KARBUSICKY
Fredericton, New Brunswick

I found remarkable the statement that "the D-Day invasion turned the tide of war against Hitler." It was turned in

February 1943 at the Battle of Stalingrad. By June 1944 there was no question whether Hitler would be defeated. The question was when. Statements like this are a relic of Western Cold War propaganda.

ALEXANDER KAZIMIROV
Ithaca, New York

reliance on foreign oil. Americans might ask themselves why such an initiative has not been launched. I suspect that the answer would point to intransigent politicians who are unwilling to face the economic and foreign policy implications. They are only delaying the inevitable.

ALISTAIR HENSLER
Ottawa, Ontario

If we are truly witnessing "The End of Cheap Oil," why is the smart money in the oil-futures market pricing oil several years

down the road at one-third lower than what it is today?

MARK CASTELINO
Newark, New Jersey

The Hummer is *the* symbol of America's consumption-propelled madness. It exemplifies our pathological, desperate drive for things we don't need; a nearly perfect selfishness; and gross, willful ignorance of secondary effects on the environment and on the safety of our fellows.

TED COFFEY
Princeton, New Jersey

The article on the shortage of inexpensive oil was very informative and thought provoking. However, I couldn't help but notice in this same issue ads promoting gas-guzzling SUVs.

SHANNON HARDING
Bellingham, Washington

The Shiites of Iraq

I would like to thank NATIONAL GEOGRAPHIC on behalf of the entire Shiite population. "Shiites of Iraq: Reaching for Power" portrayed the Shiites in an empathetic light and was a truly admirable attempt at understanding the Shiite identity and conveying it to the masses.

AFROZE FATIMA ZAIDI
Dubai, United Arab Emirates

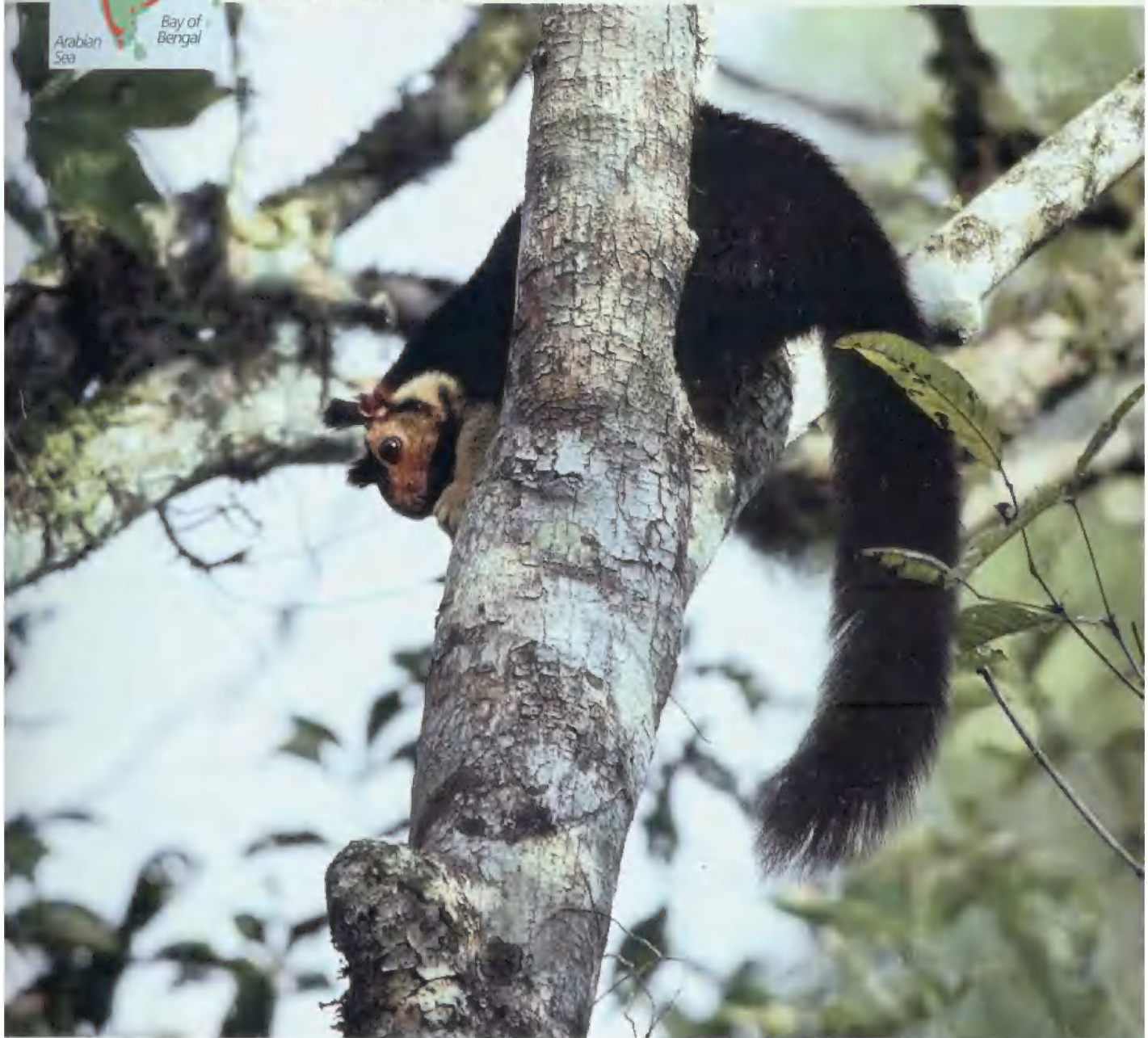
Janine Di Giovanni and Matt Moyer deserve no less than a Nobel Prize for this astonishing piece of journalism. If the TV and newspapers are to be believed, Iraq is a desert wasteland populated only by blood-thirsty, masked terrorists. Thank you for showing another side of this country.

LISA WOLFGANG
Annapolis, Maryland

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Indian Giant Squirrel (*Ratufa indica*)
Size: Head and body length, 34-45 cm; tail: 38-49 cm **Weight:** 1-2.3 kg
Habitat: Deciduous and mixed deciduous and moist evergreen forests of peninsular India, particularly in the Western Ghats mountains
Surviving number: Unknown; populations declining



Photographed by Gertrud & Helmut Denzau

WILDLIFE AS CANON SEES IT

Super squirrel? The Indian giant squirrel may not be able to fly, but its acrobatic exploits are still out of this world. When chased, it can leap as far as six meters in a single bound, using its large tail as a counterweight for balance. Its powerful claws come in handy too, allowing the squirrel to hang from branches while leaving its arms free to handle food. Truly at home in the trees—where it lives in a complex social system marked by territoriality and

dominance—the squirrel builds dome-shaped nests far above the ground. But not entirely out of reach of danger. In addition to predators, it faces the human threats of poaching and deforestation.

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Canon Inc. partnered with the Folkestone Park Foundation to help develop and install 150 cameras to monitor and protect the world's most important natural habitats.



Your story on the Shiites of Iraq, with its detailed descriptions of flourishing markets, expanded travel rights, and religious expression, never once credited American leadership, courage, and blood. You mention President George W. Bush once and American military not at all. These are yet further examples of the manner in which your political bias slants, distorts, and ultimately diminishes your otherwise excellent magazine. What is wrong with your writers and editors that you cannot properly respect the excellent American military? Here you are writing about wonderful things happening in this country in a magazine delivered near Memorial Day, yet you cannot bring yourselves to give credit where credit is due. These people deserve better.

MIKE BURNSON
Elmwood Park, Illinois

I keep returning to the large photo on pages 14-15 of the beautiful Iraqi people on the street, smiling at each other like all young people do. I want everyone to see this vibrant photo because it shows that the Iraqi people are our brothers and sisters—not some fanatic enemy. The students are so full of life in the photo. I hope they are still alive today.

SHILAH GOULD
Port Townsend, Washington

I realize that NATIONAL GEOGRAPHIC seeks relevance in today's world in its selection of articles. However, all day and everywhere you go, it is Iraq, Iraq, Iraq and terror, terror, terror. Iraq is inescapable. Give us eyes under the ocean and more of the flickers and hidden corners of America. Leave Iraq to the newspapers and nightly

I must take serious exception to your chart "The Real Cost of Gasoline." Like many, you have missed the elephant sitting in the front hall—the billions of extra dollars being spent each year for the war in Iraq.

newscasts. Please allow us our escape from the constant pounding and pontification on Iraq.

DAVID SAGER
Atlanta, Georgia

America's Front Yard

Soon the Mall will look like a junkyard. More memorials will not bring back the dead or change history. Leave the Mall alone.

GARY WITTENBORN
New Braunfels, Texas

FROM OUR ONLINE FORUM
nationalgeographic.com/magazine/0406

We should be proud of the people who have made this country a great place to live, and they should be recognized and honored in a place all can see. The Mall will always be considered as one of the most valuable parcels of land in our nation. Therefore, this is where those great people should be honored.

JOHN D. JETT
Ocala, Florida

FROM OUR ONLINE FORUM
nationalgeographic.com/magazine/0406

At Home With Flickers

I had to laugh when I read your article on flickers. The ending quote—about how their “home-building helps shape forest biodiversity”—may be a wonderful thing to you and the bird lovers of America. However, here on the Front Range of Colorado, the flicker is the most destructive bird around if you happen to live in a cedar-sided house. In the past ten years I have had to patch at least two dozen large holes in the side of my house all the way to the drywall inside. I have tried blow-up owls and snakes, and even bought a flicker house (I thought that if they had their own place, they'd leave mine alone). They sat on the owl to peck away at a hole and let starlings move into their house.

DANA DUTHIE
Colorado Springs, Colorado

Monterey Menagerie

The photographs of the strange deep-sea creatures make me wonder if anything could be brought back from some distant planet that would be any more bizarre than these animals.

DENNIS GAUNT
Iowa City, Iowa

My Seven

My Seven this month was helpful. I haven't eaten swordfish for years and because of long-lining do not purchase seafood from shops selling marlin. I will now take seven more steps toward helping the environment.

MARGARET McCONNELL
Annapolis, Maryland

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G E O G R

T H E P E O P L E , P L A C E S , A N

CONSERVATION

The Wolf Effect

Where elk fear predation, an ecosystem returns

It seemed obvious. Because wolves prey on elk, and elk feed on plants, the wolves' reintroduction to Yellowstone National Park in 1995 should have led to a decline in elk numbers (carcass along Lamar River, right). That would then explain why some plants elk eat are suddenly thriving.

But when Robert Beschta and William Ripple of Oregon State University began to study plant recovery in the park, they found a different twist. "What we're actually seeing is that the size of the elk population hasn't changed significantly," Beschta says, "and isn't the biggest factor" in the revival of certain plants—plants that impact the health of the entire ecosystem from bugs to birds to mammals.

Instead, it seems that fear of predation, not elk numbers, is driving floral recovery—by changing the ungulates' behavior. In some areas where wolves now prowl, "elk no longer hang out at streamside, browsing," Beschta says. "They're more cautious and spend less time where there's a high risk of predation. In those areas, river-loving woody plants like young cottonwoods and willows, once overbrowsed by elk, are taller than they've been in decades. Some are going gangbusters."

This suggests, Beschta says,



APHICA

CREATURES OF OUR UNIVERSE



JOEL SARTORE



JOEL SARTORI

that the extermination of wolves from the park nearly a century ago—creating an Eden for wild ungulates—may have led to the long-term decline of certain plant species. And while wolf reintroduction wasn't done to improve forest health, putting wolves back in the ecosystem may prove key to the survival of riverside plant communities, which in turn strengthen stream banks and provide shade and wildlife habitat.

"How often do you get to



DANIEL J. COX

connect wolves with warblers?" asks National Park Service biologist Doug Smith, who has headed up the wolf reintroductions. "Here you can: Wolves are, indirectly, helping to bring back nesting habitat for songbirds. As the willows recover, beavers create new aquatic habitats around which life just skyrockets." To regulate the ecosystem and maintain biodiversity, Smith says Yellowstone needs its top dog to keep the elk on their toes.

Beschta agrees. "It's one thing for us to put wolves back into Yellowstone because we took them out," he says. "It's another to put them back because the ecosystem requires it." Without wolves in the park today to scare the elk off overbrowsing, "the clock would be running out on remaining cottonwoods [left]," he warns. "They'd eventually disappear. Probably aspens too. Bringing the wolves back has been an incredible plus."

Further research should tell whether climate and fire history are also affecting floral revival, but some scientists believe they've already found the key—and not just to the Yellowstone

ecosystem. "Wolves seem to have an inordinate impact here, and I'm sure the same is true of top predators that have been lost elsewhere," says Beschta. "Perhaps now we can start to appreciate just how important a role these kinds of carnivores play."

—Jennifer S. Holland

(Un)Natural Reactions

Like wolves, other predators are keystone species whose removal causes a trophic cascade—an impact all along the food chain.

Pisaster sea stars In a classic 1966 study, biologist Robert Paine intentionally eliminated them in a Washington intertidal zone. Mussels, which are *Pisaster's* prey, exploded and pushed other species out.

Sea otters Their decline in Alaska waters has led to more sea urchins (the otters' main food), and the urchins are overgrazing kelp—harming fish, crabs, clams, and snails living in kelp beds.

YELLOWSTONE ONLINE EXTRA

For a photo gallery, downloadable map, and travel tips, go to nationalgeographic.com/magazine/0311/feature6.

MEDICINE

More Than Just a Sugar Buzz

Original Coca-Cola really did use the real thing

When Atlanta pharmacist John Pemberton invented Coca-Cola in 1886, he named it that for a reason. His "brain tonic" included extracts of the kola nut, a high-caffeine stimulant thought to be an aphrodisiac, and coca leaf extract, containing a small amount of cocaine. It's been a hundred years since Coke included that particular ingredient.

Before Coca-Cola, Pemberton had created a version of coca wine, a popular cocaine-laced beverage endorsed by Queen Victoria and Pope Leo XIII. In his



HULTON ARCHIVE/GETTY IMAGES

new cola beverage, he eliminated alcohol in a nod to the temperance movement but kept coca extract. When pharmacies began mixing his syrup with carbonated water, sales bubbled up.

In the late 19th century cocaine was hailed as a painkilling breakthrough and found in dozens of products, from throat lozenges to suppositories. But public concern began to grow about its

safety, and by 1904 Coca-Cola was completely "decocainized" (though coca extract with all

traces of the drug removed remains an ingredient to this day).

Despite the omission, Coke's popularity continued to rise, owing in part to a promotion campaign that included the bookmark at left. Growing suspicious of the drink's success, officials at the U.S. Bureau of Chemistry (precursor of the Food and Drug Administration) had a shipment of Coke syrup seized in Chattanooga, Tennessee, in 1909. The product, they charged, violated the Pure Food and Drug Act of 1906, prohibiting sale of "adulterated or misbranded" foods. The "adulterating" chemical: caffeine. The government lost its case.

—Margaret G. Zackowitz

More Strange Elixirs

Heroin Marketed as a cough medicine, 1898 to 1913

Opium Used in vaporizers to treat asthma, around 1900

Morphine Used in a syrup for quieting infants, also around 1900

VOLCANOLOGY

Sniffing for Clues to Dinosaurs' Demise

From Pompeii to Montserrat, history teaches caution in the presence of a smoking volcano. So Ken Sims's job seems a bit counterintuitive. Braving possible eruptions and choking gas, Sims, a geochemist at Woods Hole Oceanographic Institution, rappels into volcanoes like Nicaragua's Masaya (right) and takes samples of the exhaust emitted from magma tubes. Though the ground near the Masaya magma pit, at upper center, collapsed just days after he'd been there, Sims thinks the risks he takes are worth it: By comparing his data with sediment and ice core



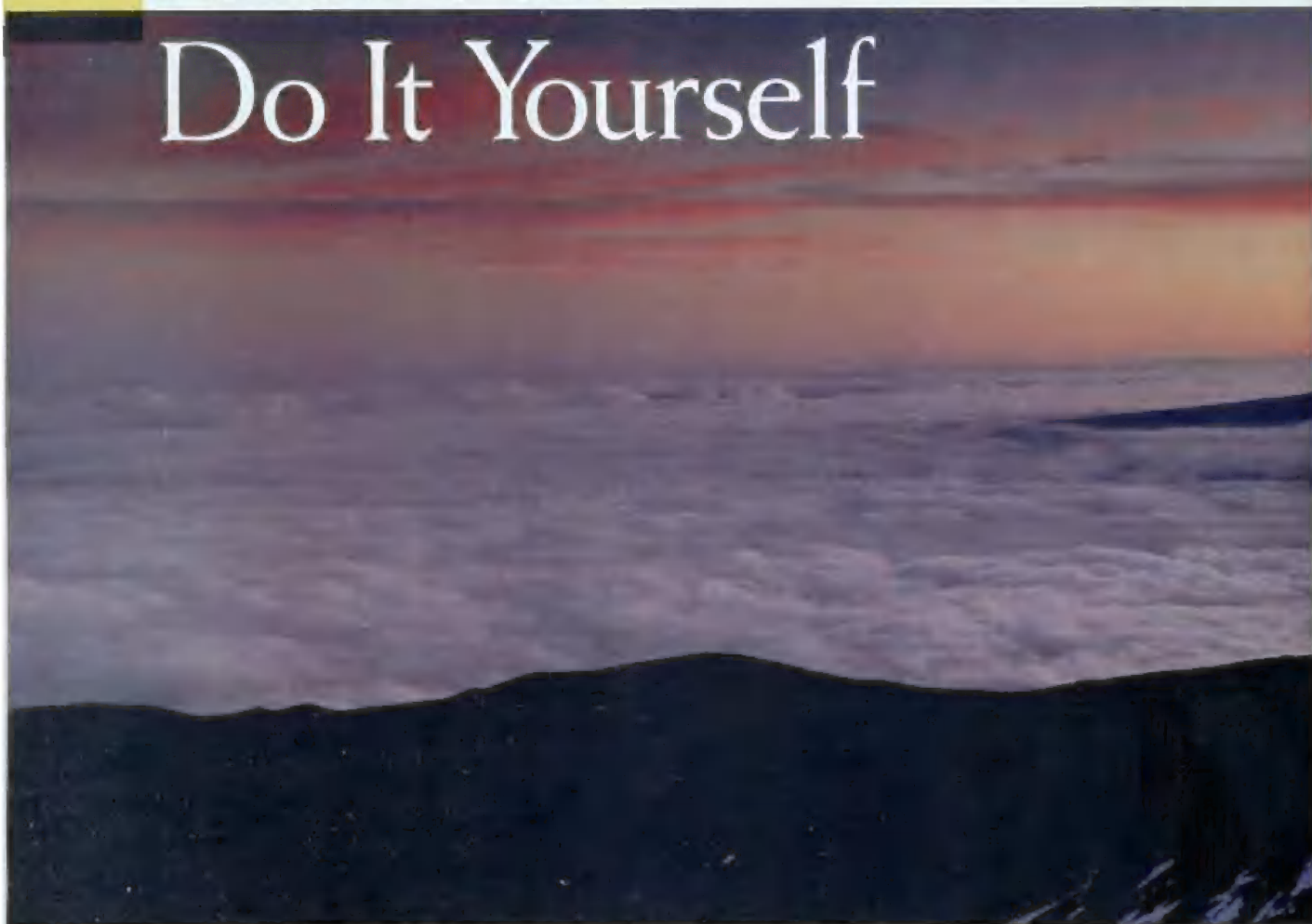
JOHN CATTO, ALPENGLOW PICTURES

samples from around the world, he thinks he'll find out more about the link between volcanic eruptions and ancient climate shifts, like the one that may have contributed to the demise of the

dinosaurs. "There's a debate over volcanoes or meteorites as the cause," Sims says. His research may be useful in understanding modern climate change as well.

—Chris Carroll

Do It Yourself



HAWAI'I VOLCANOES NATIONAL PARK (SEE PAGE 2)

GO THERE

Hike to Halapē . . . If You've Got What It Takes

Where volcanoes reign, so do black-sand beaches. But on the park's southwest coast, Halapē offers a remote and lovely white-sand cove to anyone weary of black rock (and seeking a hearty challenge). The two-day round-trip over varied terrain, which drops a steep 2,700 feet over seven miles, isn't for everyone, as the sign at the Mau Loa o Mauna Ulu trailhead—posted at the rough edge of a wind-beaten lava field—makes clear. Beware, it warns, of deep earth cracks, loose rocks, thin lava crusts, earthquakes, tsunamis, and rough seas. Dehydration, heat exhaustion, and sunstroke are other potential hazards. Do not hike



G. BRAD LEWIS

after dark, the sign strongly suggests, and prepare for intense sun, strong wind, and driving rain. Still up to the task? Primitive shelters await, but you'll need a permit to stay there—so stop at the Kilauea Visitor Center before you head out. Oh, and bring water. Lots and lots of water.

PICKS

3 spots

Some of author **Jennifer Holland's** favorites:

■ **Koa Forest**

Drive partway up the Mauna Loa strip road and lounge beneath the welcoming trees.

■ **Wild Lava Tube**

Sign up at the visitor center to tour a wild lava tube, complete with stalactites and sightless spiders. Be prepared to scramble over big rocks by flashlight.

■ **Rain Forest** 'Ōla'a For-

est, just outside the main park, lacks clear hiking trails, but a walk beneath the thick canopy is worth getting your shoes muddy.



CHRIS JOHNS, NGS STAFF

WHEN TO GO

Nēnē? Yes, Yes: A Rare Bird

The ideal time to visit Hawai'i Volcanoes is, obviously, when lava is spouting high or snaking to the sea. But it's tough to plan around Pele's fickle moods. So perhaps go for a glimpse of wildlife: From mid-May through August,

fledglings of the *nēnē* goose, the rare and endangered Hawai'i state bird, are out and about. With only 12 to 15 fledglings annually in the park, the population is just hanging on, and a sighting is a special treat.

"If you're lucky enough to see a family group [adults, left], you can tell the youngest birds by their dusker coloring, the incomplete black ring around the neck, and the high, squeaky voice," says park ranger Darcy Hu.

Young *nēnē* are also less cautious than their elders—but don't take that as an invitation to approach, and feeding the birds is strictly prohibited. "We have a 60-foot rule of thumb," Hu says. "The best way to watch the *nēnē* is from at least that distance with binoculars." For more on the *nēnē* and other park wildlife go to nps.gov/havo/resource/nene.htm.

What's Bad for the Goose

A rogues' gallery of introduced species threatens the ground-nesting *nēnē*. Rats, mongooses, and feral pigs gobble up eggs and goslings, and feral cats prey on adult birds. Loss of forage and nesting habitat adds to the burden. Traps and registered toxicants help reduce alien predators but are useless against another *nēnē* nemesis: the speeding car.

TRAVEL TIPS

Get the goods on the park—the who, what, when, and how of traveling there—at nationalgeographic.com/magazine/0410.

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FRANS LANTING

TRY IT AT HOME

Virtual Volcano: Track Eruptions via the Web



G. BRAD LEWIS

Can't make the trip to Hawai'i? Visited during a lull in volcanic activity? You can still keep up with the action (or inaction) on the website of the Hawaiian Volcanoes Observatory, part of the U.S. Geological Survey: hvo.wr.usgs.gov. Scientists there monitor every twitch and burp of erupting Kīlauea (left) and massive

Mauna Loa (above, with dormant Mauna Kea in the foreground.) Only because they were able to accompany working geologists could the article's author and photographer get as close as they did. If you're looking to spend time in the field, the website explains the observatory's rigorous volunteer program.

GET MORE

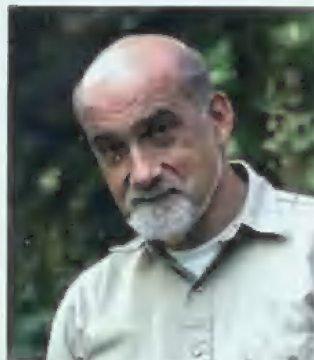
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FROM THE SOCIETY

- **Hawaii Volcanoes National Park Trails Illustrated Map.** A tear-resistant, waterproof topographic map to help navigate through the park. Highlights hiking trails, backcountry wilderness regulations, and safety and survival tips (\$9.95).
- **National Geographic Traveler Hawaii.** This guidebook includes information on the park's visitor center—and its only hotel (\$22.95).
- **TOPO! Hawaii** CD-ROM set. A seamless view of the islands allows you to zoom in on the park to create and print your own USGS topographic map with 3-D relief shading. Customize it with elevation profiling, routes, Web links, and photos (\$99.95).

My Seven



Endangered Treasures of the Past

Henry Wright *Archaeologist, University of Michigan Museum of Anthropology*

Henry Wright says our history is vanishing. He's studied the remains of civilizations worldwide, and he worries that "50 years from now we won't have enough of an archaeological record left to answer fundamental questions about our past—and our possible futures." Here's his list of the most endangered archaeological sites, and why they're in trouble.

1 Iraq's early cities (4000 to 1200 B.C.) Some of Mesopotamia's earliest cities (right) are being destroyed by thieves seeking statues, bronzes, and tablets with cuneiform writing.

2 Towns of Mali (500 B.C. to A.D. 1400) On the Niger's inner delta, thousands of townsites, including the oldest in sub-Saharan Africa, are being mined for terra-cotta artifacts.

3 Mississippian culture (A.D. 900 to 1700) To improve agricultural yield and make way for development in America's Mississippi Valley, thousands of Native American villages and temple centers have been flattened.

4 Khmer cities and temples (A.D. 200 to 1350) These ruins in Southeast Asia are no longer shrouded



MICHELLE ANDOMIAN (TOP); MATT MOYER, WORLDPICTURENEWS

by jungle. Continuing conflict makes it easy for armed gangs to loot irreplaceable Khmer statuary for profit.

5 Shipwrecks In all the world's seas, shipwrecks—some more than 5,000 years old—are now accessible to latter-day treasure hunters who are equipped with high-tech sensing and recovery technologies.

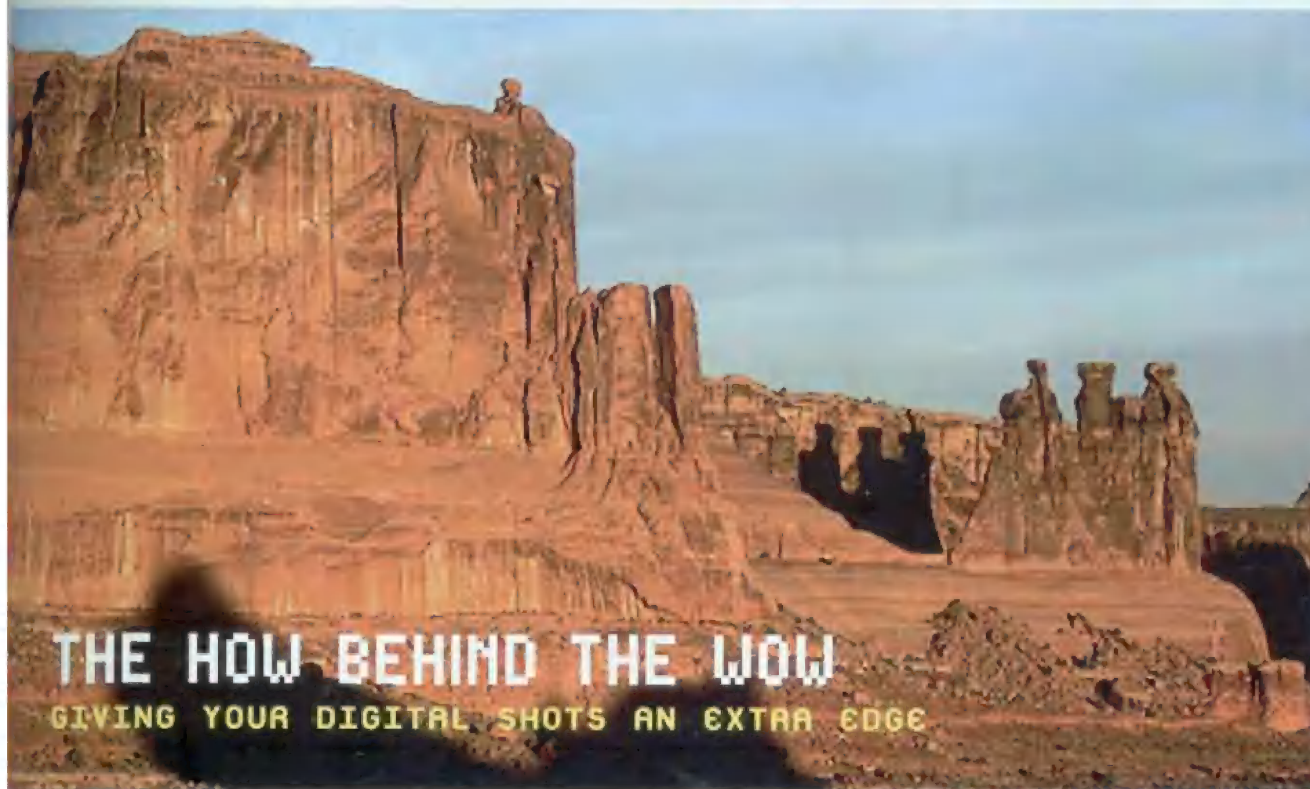
6 Maya cities (A.D. 250 to 900) They're being stripped of stelae and carved stone reliefs just as we're learning to read their glyphs as the history of early Maya royalty.

7 Peru's royal tombs (200 B.C. to A.D. 1450) Grave robbing has accelerated as thieves have learned where tombs are hidden.

Because Peru's early dynasties didn't develop a writing system, studying the rich fabric and gold jewelry from tombs is the best way for us to document the rise and fall of the first Andean kingdoms.

WEBSITE EXCLUSIVE

Henry Wright led a National Geographic Society expedition to assess Iraq's antiquities in 2003. Read about it at nationalgeographic.com/magazine/0310/feature3.



CREATING

More than any other digital feature, that little LCD display panel on the back of your camera can revolutionize your results. Use the LCD to:

- Instantly check every image to be sure you get what you want
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Power up

Digital cameras use batteries up quickly. If you always have three sets, you can go out to shoot with a fresh set in your camera, another in your bag, and third on your charger so it's ready to go when you return.

ENHANCING

Welcome to the digital darkroom

By enhancing your photos on the computer, you can help them communicate more strongly.

Use this step-by-step process as a guide for maximizing control, accuracy, and results.

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- 5.) Sharpen and prepare for printing

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Back up your images outside of your computer. A CD-R, DVD-R, or DVD+R disk will save your work if your hard drive crashes. And be sure to buy higher quality recordable disks with long life to ensure your image data will remain stable.

TRY THIS TIP <<<

LOW LIGHT WILL INCREASE DIGITAL GRAIN. USE A FLASH TO KEEP GRAIN AT A MINIMUM.

Who Knew?

CLIMATOLOGY

Green Sahara

The great desert where hippos once wallowed

The Sahara sets a standard for dry land. It's the world's largest desert. Relative humidity can drop into the low single digits. There are places where it rains only about once a century. There are people who reach the end of their lives without ever seeing water come from the sky.

Yet beneath the Sahara are vast aquifers of fresh water, enough liquid to fill a small sea. It's fossil water, a treasure laid down in prehistoric times, some of it possibly a million years old. Just 6,000 years ago the Sahara was a much different place.

It was green. Prehistoric rock art in the Sahara shows something surprising: hippopotamuses, which need year-round water.

"We don't have much evidence of a tropical paradise out there, but we had something perfectly livable," says Jennifer Smith, a geologist at Washington University in St. Louis.

The green Sahara was the product of the migration of the paleomonsoon. In the same way that ice ages come and go, so too do monsoons migrate north and south. The dynamics of the Earth's motion are responsible. The tilt of the Earth's axis varies in a regular cycle—sometimes the planet is more tilted toward the sun, sometimes less so. The axis also wobbles like a spinning top. The date of Earth's perihelion—its closest approach to the

sun—varies in a cycle as well.

At times when the Northern Hemisphere tilts sharply toward the sun and the planet makes its closest approach, the increased blast of sunlight during the north's summer months can cause the African monsoon (which currently occurs between the Equator and roughly 17°N latitude) to shift to the north as it did 10,000 years ago, inundating North Africa.

Around 5,000 years ago the monsoon shifted dramatically southward again. The prehistoric inhabitants of the Sahara discovered that their relatively green surroundings were undergoing something worse than a drought (and perhaps they migrated toward the Nile Valley, where Egyptian culture began to flourish at around the same time).

"We're learning, and only in recent years, that some climate changes in the past have been as rapid as anything under way today," says Robert Giegengack, a University of Pennsylvania geologist.

As the land dried out and vegetation decreased, the soil lost its ability to hold water when it did rain. Fewer clouds formed from evaporation. When it rained, the water washed away and evaporated quickly. There was a kind of runaway drying effect.

By 4,000 years ago the Sahara had become what it is today.

No one knows how human-driven climate change may alter the Sahara in the future. It's something scientists can ponder while sipping bottled fossil water pumped from underground.

"It's the best water in Egypt," Giegengack said—clean, refreshing mineral water. If you want to drink something good, try the ancient buried treasure of the Sahara.

—Joel Achenbach

WASHINGTON POST STAFF WRITER

Beating the Heat

To cool down when the air around them heats up, mammals pant, burrow, wallow, and sweat. But sweating releases a lot of water, a more precious commodity in today's harsh Sahara than it was 6,000 years ago, when hippos there had enough to wallow in. Camels do sweat, but they can keep it to a minimum to conserve water. How? They're able to withstand fluctuations in body temperature—more than 10°F—that could kill other mammals, including humans. A camel's body temperature rises during the day, sometimes above 104°F, then can fall to as low as 93°F at night.

—Heidi Schultz

WEBSITE EXCLUSIVE For more on the Sahara, and for links to Joel Achenbach's work, go to Resources at nationalgeographic.com/magazine/0410.

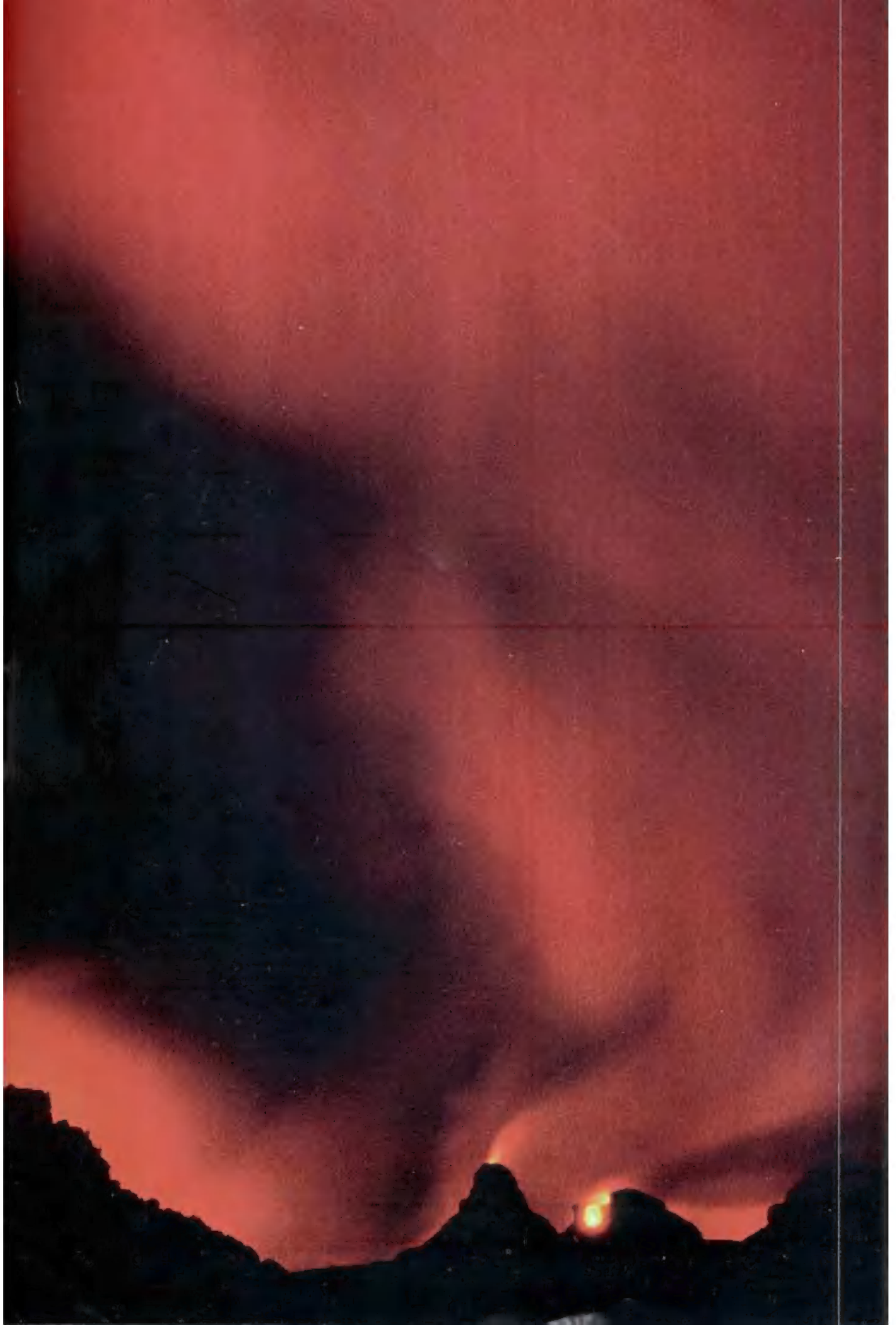


AMERICAN LANDSCAPES

Red Hot

BY JENNIFER S. HOLLAND
NATIONAL GEOGRAPHIC SENIOR WRITER

PHOTOGRAPHS BY FRANS LANTING



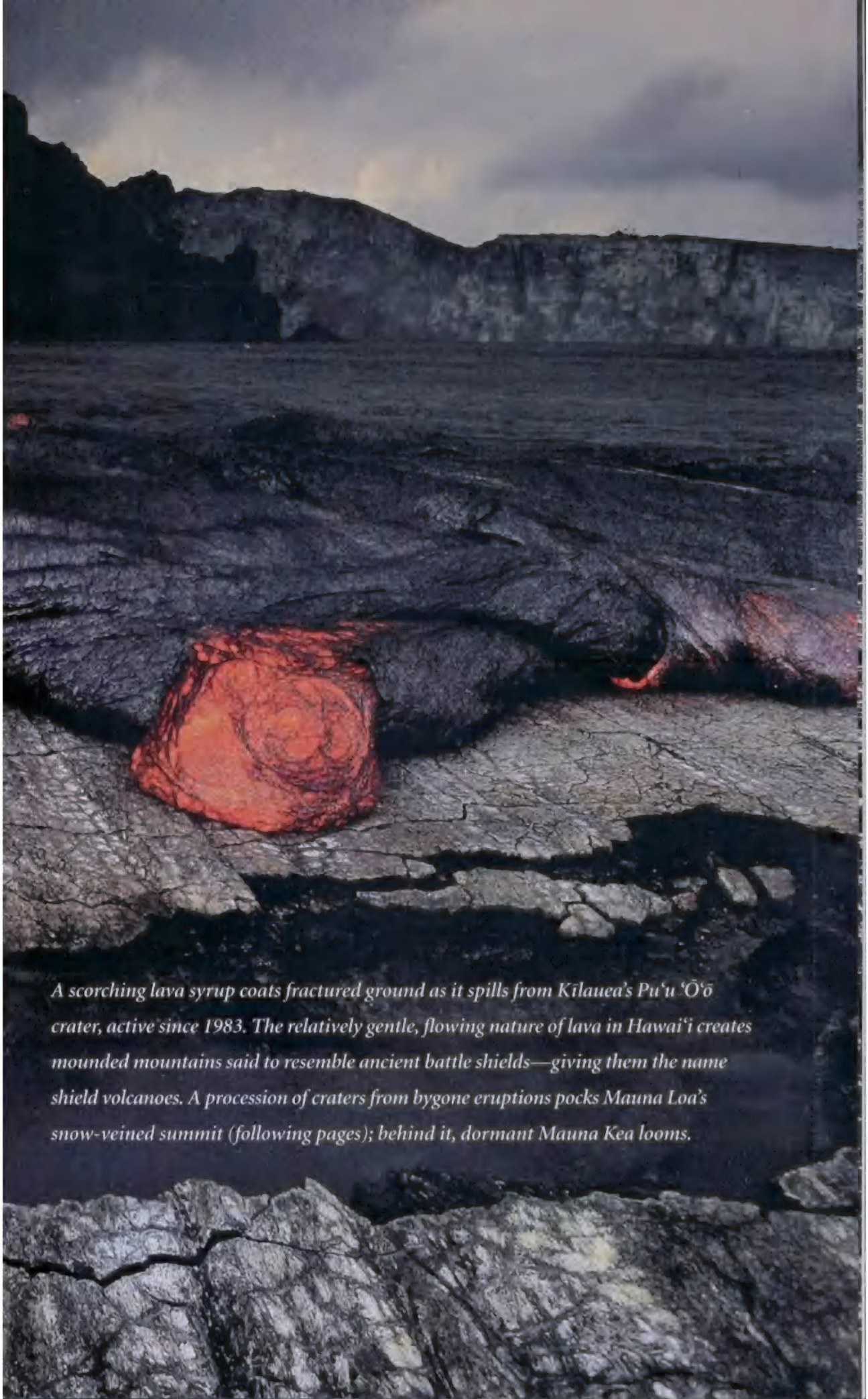
*Gas tinged crimson
by volcanic heat bleeds
from restless Kīlauea,
where a sinuous river
of lava breaks free
(overleaf). In the volatile
landscape of Hawai‘i
Volcanoes National Park,
annihilation is also
Earth’s unending birth.*



Hawaii

VOLCANOES NATIONAL PARK





A scorching lava syrup coats fractured ground as it spills from Kīlauea's Pu'u 'Ō'ō crater, active since 1983. The relatively gentle, flowing nature of lava in Hawai'i creates mounded mountains said to resemble ancient battle shields—giving them the name shield volcanoes. A procession of craters from bygone eruptions pocks Mauna Loa's snow-veined summit (following pages); behind it, dormant Mauna Kea looms.







Even as lava snakes from Pu'u 'Ō'ō (above), new life mends the wounded cinder plain farther downhill (right). Here, two decades ago, curtains of molten earth shot skyward and encased trees in stone. Now pioneering ferns find damp warmth in the torn land.

“A

NY ONE OF NATURE'S MOST celebrated wonders” will at first disappoint the visitor, wrote Mark Twain during a trip to Kīlauea volcano in 1866, “but on better acquaintance will swell and stretch out and spread abroad, until it finally . . . becomes too stupendous for his comprehension.”

Hawai'i Volcanoes National Park is like that. The shield-shaped mounds that are active volcanoes are, initially, a little hard to take in—they don't scream out “fire-breathing dragons.” And the craters of past eruptions that pock the land are too severe to be beautiful, too vast for even a nature lover's open arms.

At first.

Then everything changes. Tiptoe over licorice twists of cooling lava, bathe in a spire of earthly steam, and bow closer to the fern that miraculously grabs a foothold in fresh stone. Listen to Hawaiians' tales of their volcano goddess, Pele, and begin to notice her everywhere: in debris fields of rocks blown from once fiery pits, in frozen seas of lava, in graveyards of petrified trees, in the acrid scent of sulfur dioxide that blows from Kīlauea's east rift zone. Then visit her sweltering den, Pu'u 'Ō'ō crater, where Kīlauea's current eruption began explosively in 1983 and has since oozed enough lava to pave five roads to the moon. Realize, finally, that Hawai'i Volcanoes is forever a work in progress: the most volatile and dynamic park on Earth.

Congress first moved to protect the area's volcanic summits in 1916, when Hawaii was still just a U.S. territory. Now the national park covers more than 500 square miles on the Big Island, including Kīlauea and Mauna Loa volcanoes with their cinder fields, scrubby deserts, forests of ramrod *koa* and red-blooming 'ōhi'a trees, plus swaths of rain forest so tangled that few but botanists and entomologists clamber through.

One of Pele's residences lies at Halema'uma'u Crater, which was for 150 years Kīlauea's most active vent. Hawaiians and visitors from around the world come to the now silent crater's edge to worship and to leave gifts of all sorts for the goddess “You'll see everything from fake money to raw pig heads out here,” says park ranger Faelyn Jardine, who each week lugs out a trash bag of what the park service considers “inappropriate” leavings. “The preferred offerings,” she says, hoisting a hefty bulgik with random groceries and a pair of baked chickens, “are chants and prayers.”

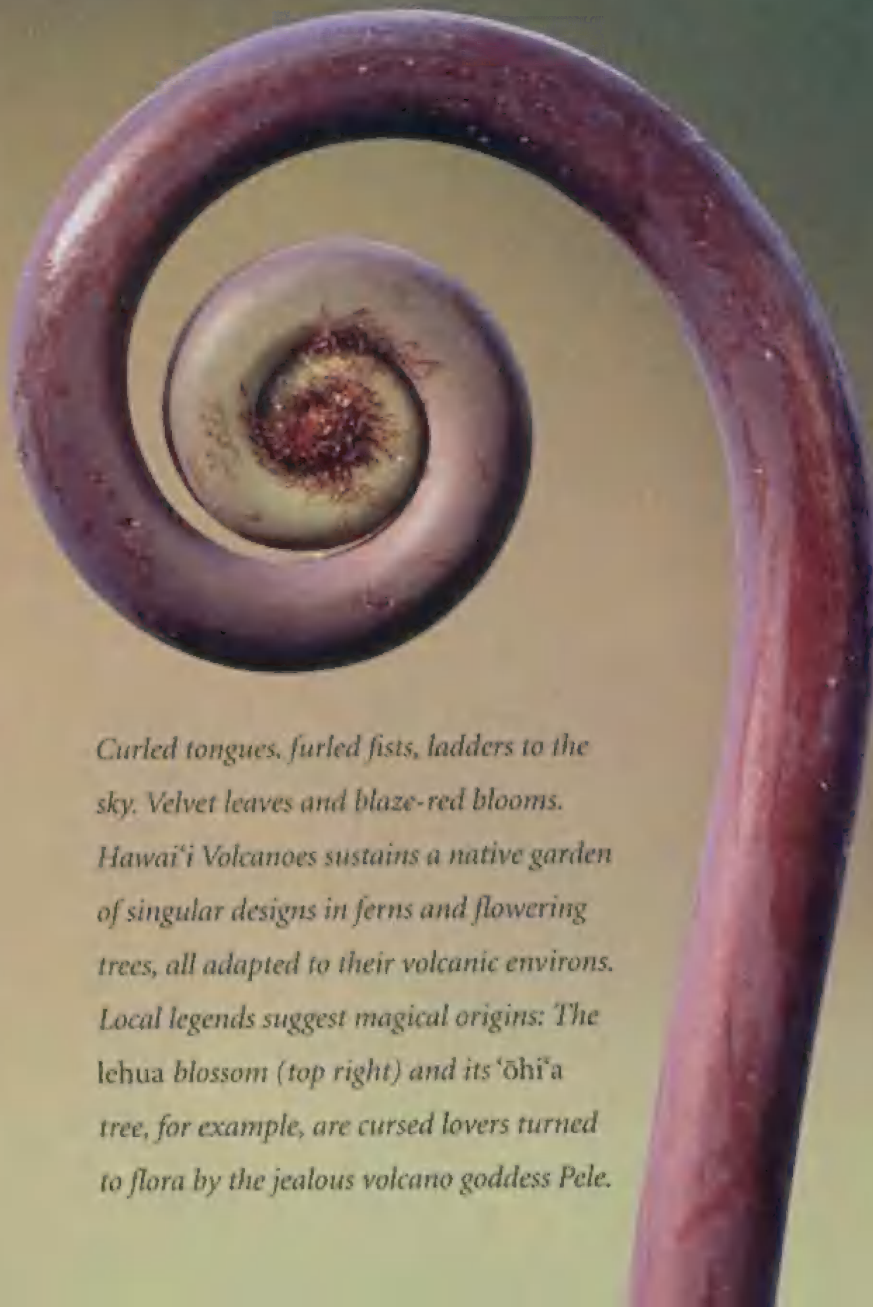




METROSIDEROS POLYMORPHA ('ŌHI'A LEHUA, VELVET LEAVES)
DICRANOPTERIS LINEARIS (ULUHE)



SADLERIA CYATHEOIDES ('ĀMĀ'U)
DICRANOPTERIS LINEARIS (ULUHE)



Curled tongues, furred fists, ladders to the sky. Velvet leaves and blaze-red blooms. Hawai'i Volcanoes sustains a native garden of singular designs in ferns and flowering trees, all adapted to their volcanic environs. Local legends suggest magical origins: The lehua blossom (top right) and its 'ōhi'a tree, for example, are cursed lovers turned to flora by the jealous volcano goddess Pele.



METROSIDEROS POLYMORPHA ('ŌHI'A LEHUA, FLOWER)
SADLERIA CYATHEOIDES ('AMA'U)



It's easy to understand why so many come here bearing gifts, for they feel powerful spirits rumbling beneath this land. Not just Pele, but dozens of others, controlling the lava, storms, fires, winds, trees, and the many moods of the ocean.

The Big Island itself has explosive—and recent—origins. About 700,000 years ago it was blasted from a stationary hot spot within the Earth before being rafted away, like its elder sister islands, on the northwestward-drifting Pacific plate. The hot spot continues to give birth: A seamount called Lō'ihi, its summit 3,000 feet below the waves, is building with each submarine eruption; 50,000 or so years from now it should break the water's surface. Of the state's four other active volcanoes, only the park's Kīlauea and Mauna Loa have spit lava in the past 200 years. Since Kīlauea's most recent eruption cracked through its east rift zone in 1983, lava from the volcano has added about 570 acres of land to the Big Island's southern coast.

Sam Kahookaulana has seen what volcanoes can do. The longtime park employee was raised beneath lava-blushed skies in Kalapana, a town that in 1990 was devoured by a Kīlauea eruption. Little remains there today but a painted church that townspeople scrambled to move out of harm's way. The road ends, literally, at a macadamia nut stand, with a posse of skinny, good-natured dogs basking where ocean, rather than a solid sea of lava, once kissed the shore.

"We have no control over the volcanoes, no more than over the waves, the stars, the moon," Sam says. "So all you can do is just live your life for today."

Because there's no telling these volcanoes what to do, many native Hawaiians seek

Tremors buck the park, sometimes hundreds a day. Wind whips endless flags of volcanic steam—then drives sudden showers of cold rain.

to explain and justify the mountains' motives in tales of moody gods in love and at war. To outsiders, Pele may seem to be on the warpath, with fiery and devastating consequences. But, explains Keola Hanoa, who as a "Pele practitioner" worships the goddess, "We don't see her work as destruction but as cleansing. She's a creator. When she comes through, she wipes the land clean and leaves us new fertile ground. We don't get mad. It is all hers to begin with."

Keola says her 81-year-old mother, Pele, is the goddess's direct descendant. "In a dream about fire, my grandmother was told to name her Pele," Keola explains. Other family members were subsequently named for the deity's siblings. "My mom may look like the little old lady from Pasadena, but she's linked to a higher power. Pele, our *tutu*, our grandparent, is everything: the steam, the lava, the land. And my mother was handpicked to represent her."

Aunty Pele (Aunty is a Hawaiian title of respect) is a wisp of a woman with lovely caramel skin and a cap of thick black hair. She is quiet and poised, in contrast to her temperamental, lusty namesake. She's come to the park's visitor center to bless a new painting of the goddess. Wearing big glasses, a long red dress and floral crown to match, she faces the deity's bold image on the wall and prays aloud in Hawaiian, a bit of song in her voice. Then, still chanting, she walks through the room flicking water from a bowl of floating ti leaves into each corner with her fingers. Later she says that she had waited for a sign to tell her what to do. "I got up this morning and it came to me, that I should prepare the salt water, that I would sprinkle it through the room. So that's what I did. In my prayer I asked Pele to protect this park and all the workers, and I cleansed the room of evil spirits."

So saturated in spiritual lore is Hawai'i Volcanoes National Park that even the most scientific minds may bend to incorporate it. By day, volcanologist Don Swanson of

Hawai'i



The Hawaiian Islands erupted one by one as the Pacific plate drifted over a hot spot in the Earth. Keeper of the flame, the island of Hawai'i houses three active volcanoes; two, Kilauea and Mauna Loa, lie within the 520-square-mile national park.

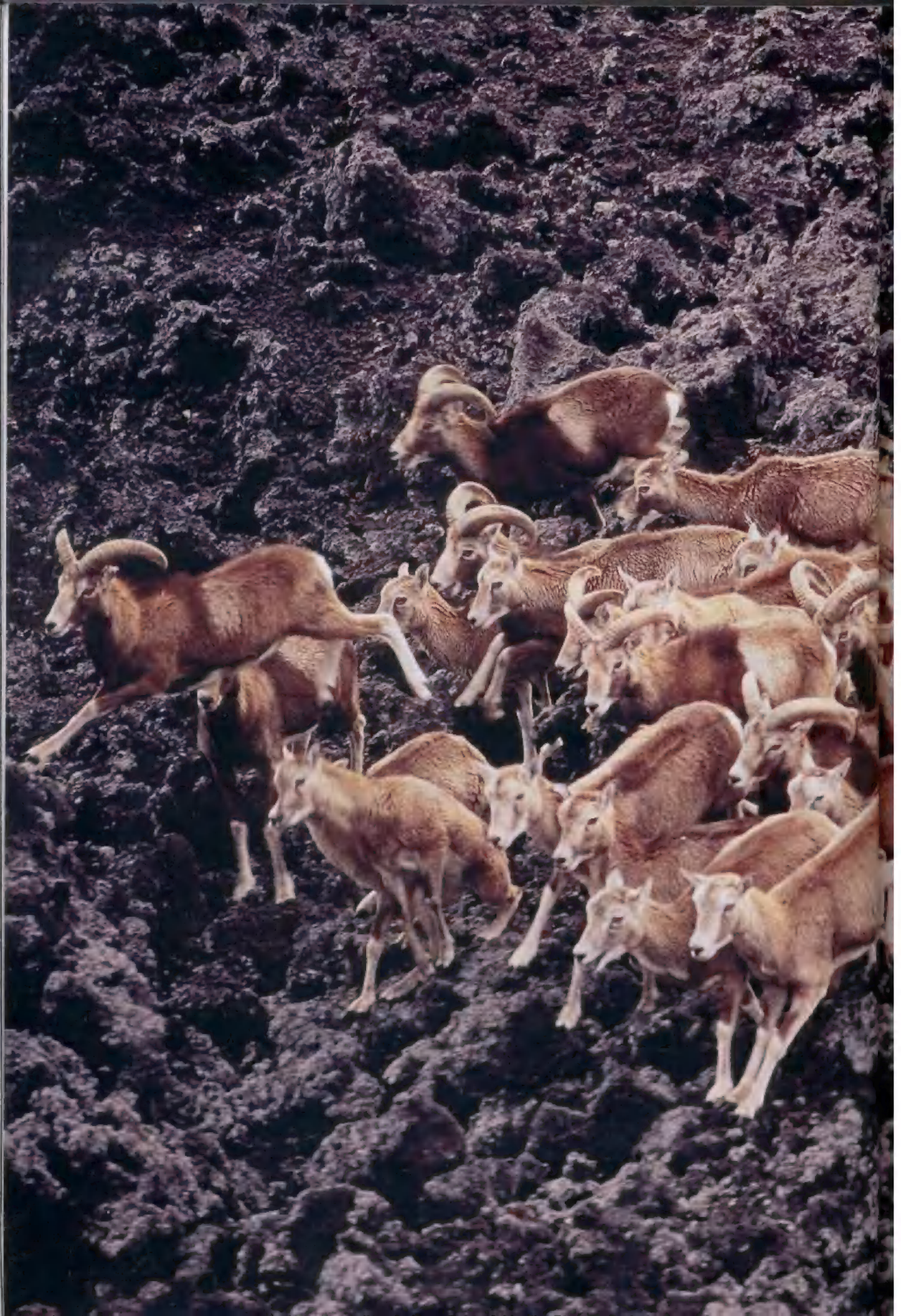
the U.S. Geological Survey measures temperatures and gases and analyzes data from seismographs and tilt meters, which detect changes in ground swelling.

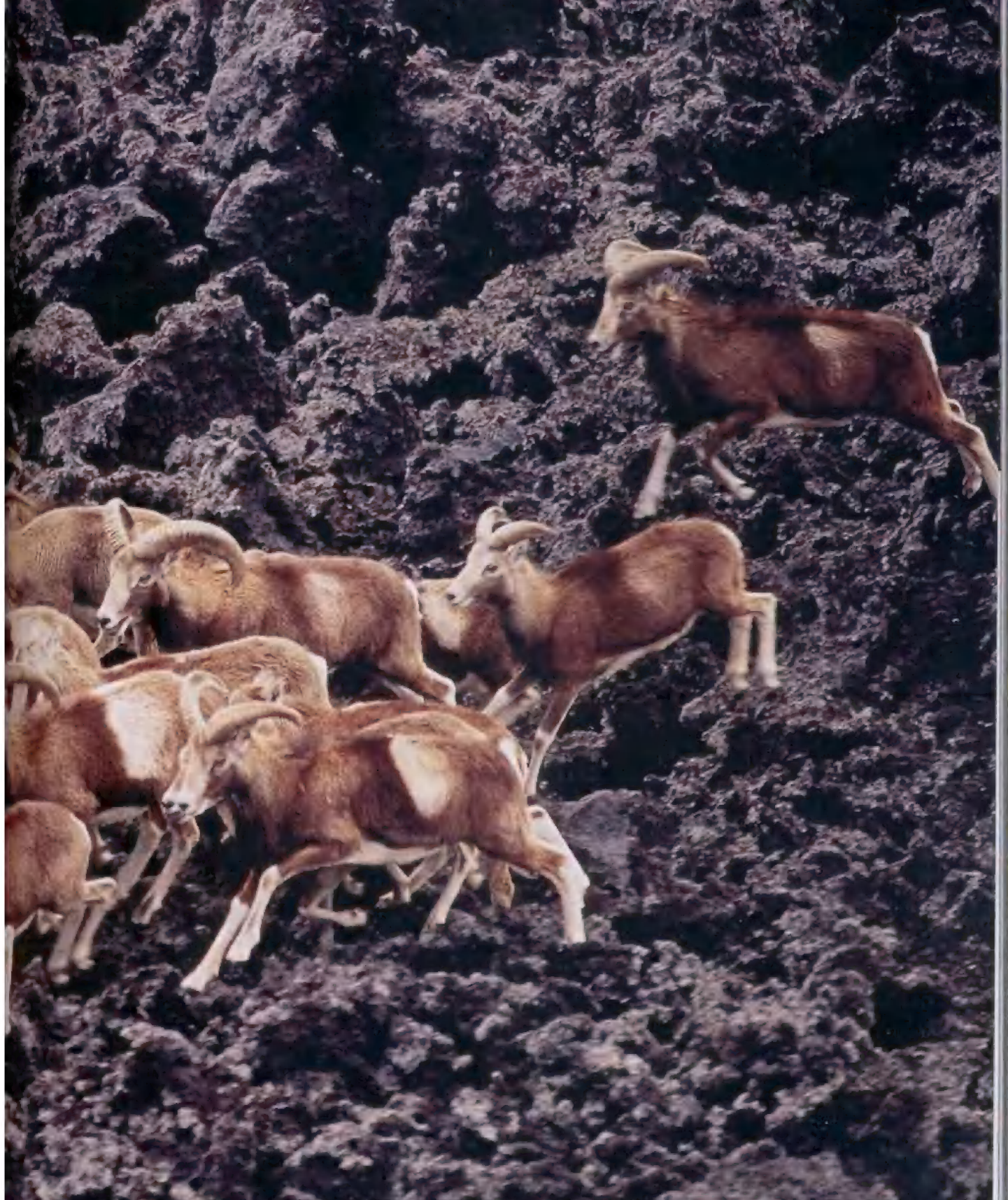
He fishes for lava samples "with the business end of a sledge hammer on a piece of stainless steel wire," cools those samples in a coffee can, and studies their content. But such intimacy with Earth's most elemental powers has inspired him to step into another realm in his off hours, seeking geologic truth in Hawaiian legend. "It's there," he says. "There are instances where it's clear that what's described in chant and song is a metaphor for what really happened."

One tale describes a jealous Pele torching the 'ōhi'a forest of her youngest sister, Hi'iaka, whom she suspected of stealing her lover. She then killed the lover—forcing Hi'iaka to dig for his body. Swanson suggests these acts echo the two largest volcanic events of Polynesian times: a 60-year Kilauea eruption in the 1400s, in which vast tracts of forest burned, and its rock-flinging summit collapse around 1500. "Only in recent years have we scientists been figuring out the proper sequence of events," Don says, "but it was all in the stories if we'd had the foresight to look there first."

THE APOCALYPTIC BLACKNESS of old lava has that end-of-the-world feel to it. Meandering across Kilauea's summit caldera, I feel like a sole survivor, my boots sliced open from the rough and buckled earth. Both Hawaiian lava types, the hot, rumpled cloth called *pāhoehoe* and the cooler, creeping volcanic slag called 'a'ā—which hardens into brutally jagged edges—are here. Porous lava nuggets glint green with olivine, and nests of volcanic glass called Pele's hair, which shoot out from the hottest *pāhoehoe*, glint gold.

Stone cairns, called *ahu*, built by park staff for visitors, mark a trail of sorts through this basaltic bowl. Quiet since the 1980s, the caldera is now staging life's bold return: Pioneering white lichens frost parts of the pavement, helping to break it down so other plants can grow. Occasional shrubs droop with tangy 'ōhelo berries. And like





Mouflon sheep prefer the woods and pasture of the former Kahuku Ranch—the park's recent 116,000-acre acquisition—to its fields of jagged 'a'a lava. But this species, brought here in the 1960s for hunting, has adapted to even the unlikeliest habitat. Park managers hope to cull the plant-eating ungulates so endemic flora can thrive.



Forest whittled to its bones, a stand of 'ōhi'a too close to Kīlauea's active vent was downed by toxic gas, ash, and lava-ignited fire. Away from the eruption site, giant native tree

tiny periscopes checking for danger, rows of fern leaves poke their heads through the splintered rock. That anything can grow where sulfur gas—a volcano's natural emission—and acid rain pervade is remarkable. 'Ōhi'a trees can take root on lava within a few years, and can shut down stomata in their leaves when the air is poor. Eventually these and other native flora will turn the bleak lava field woody again—to resemble lands elsewhere in the park that have had time to make a comeback.

Like Kahuku. The 116,000-acre former ranch, acquired last year by the park and the Nature Conservancy, is still striped black with old lava fields. But brighter shades abound in the rolling, cow-studded pastures, and in the koa and 'ōhi'a forests and scrubland. Volcanologists are giddy over the property's location on Mauna Loa's most active rift zone, and park archaeologists will be surveying its 700-year-old ruins. For conservationists it's a land of promise: If invasive species can be controlled, many more native ones, some endangered, will flourish. So revered is the new parkland that my Hawaiian guides there observed *kapu*, or sacred law, by chanting to the gods for permission before we wandered about in a hallowed grove of trees.

Looming large above the ranch, Kahuku's matriarch, Mauna Loa, has been eerily quiet since 1984. The most massive mountain in the world (50 times the bulk of Mount Fuji), its 13,679-foot elevation from sea level is merely the tip of a volcano that rises 42,320 feet from the ocean floor—which is actually sinking beneath its weight. History suggests Mauna Loa is overdue to erupt, and scientists say the summit has been gradually swelling since, appropriately, Mother's Day 2002. But its eruptions usually follow months of increased seismic activity. For the moment, all is still.

Not so on the adolescent Kīlauea, of course, which barely tops 4,000 feet. The active Pu'u 'Ō'ō crater is about 12 miles from the mountain's summit, and there's no easy way to get to where the action is. I hitch a special helicopter ride to camp out about a mile below the crater in a *kīpuka*—the name for a wooded oasis (and vital seed bank) spared, by chance, from lava. Just outside this floral island, trees stand stopped in time, like victims of Vesuvius. Their lava-encased trunks have burned away inside, leaving behind eerie, craggy-faced gnomes of stone.

The volcanic smog is thick and sour; I strap on a gas mask and hope for a change in the wind as I practice walking on what's called shelly pāhoehoe, the newest lava—



ferns reclaim the landscape. But elsewhere in the park invasive plants inhibit native growth and fuel fires sparked by lava, lightning, and careless humans, altering nature's course.

some just a week old—that leads up to the vent. Its silvery sheen is alluring, but the surface of glassy scales turns to powder beneath your feet. If you aren't careful, you can crash through to the older lava layers below—to the knee, waist, or even over your head. Brad Lewis, a volcano photographer and my guide, calls it a liquid sidewalk. "Walk in the seams," he instructs, "and without forward momentum."

Beyond what seems to be endless shelly pāhoehoe, the Pu'u 'Ō'ō crater rim awaits. It's the true edge of creation, on this day a gaseous pit studded with fiery cones—hollow lava ovens formed by cinder and spatter. The crater's giant south wall is partly collapsed; what's left standing is markedly slumped, seeming weak in the knees. "This place is always shape-shifting," says Brad, pointing out where a series of spatter cones

To outsiders, Pele may seem to be on the warpath. But "we don't see her work as destruction but as cleansing. She's a creator."

that formed just days ago has caved in, and where new ones are beginning.

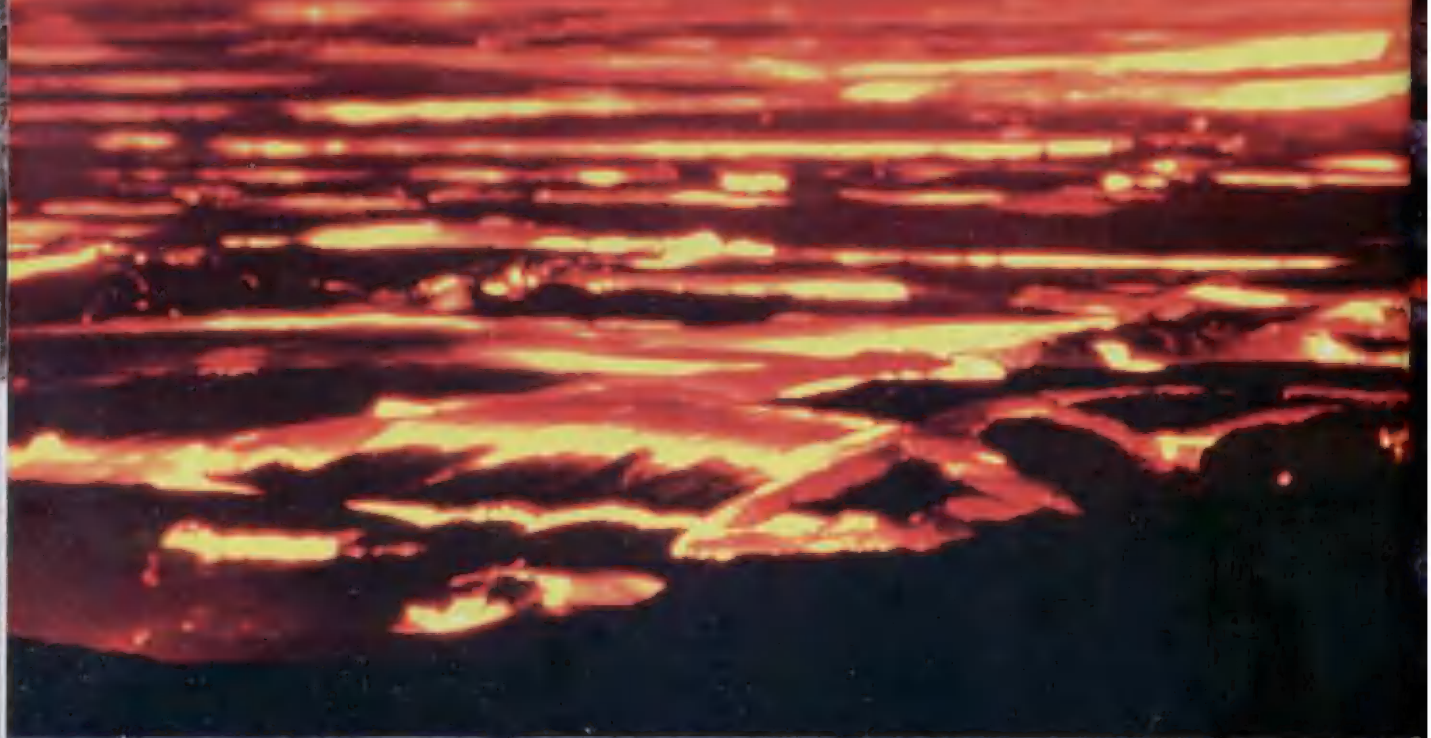
Foul, raw gas billows from every crevice, filling the hundred-foot-deep sink with primordial atmosphere. Only a week before, this crater was lit by magma-spewing fountains, the liquid earth filling the chasm with a frothy, roiling lake. When it overflowed, fingers of lava crawled slowly down the spillways.

But today the action is all below the surface: The lake bed is quiet. Lava that didn't drain back inside the vent after the overflow has pooled, cooled, and hardened. The crater wall on which I'm standing has split in two, revealing a black layer cake, pages in the mountain's history book. But like everything here, those pages are as transient as wind. Tomorrow the view from this spot will be something new. Next week, it might be unrecognizable.

That night a red-orange glow—gas illuminated by the lava beneath—hovers over Pu'u 'Ō'ō like a miraculous sunset. Even without the magma spray and lava streams of more active days, the volcano's energy is present like a hand on my shoulder, its muted booms drumming on into the night.

(Continued on page 24)

Kīlauea's molten sea shimmers at night like the sun. Following the contours of old flows, creeping lava envelops a strip of elevated stone (bottom). The hottest Hawaiian lava type, called pāhoehoe (meaning smooth lava), may darken into ropy strands (top right) or wrinkle into silver-sheened taffy that shatters beneath the lightest footfall.







"It was like looking back to when the Earth was being born," says photographer Frans Lanting of Pu'u 'Ō'ō's most massive spatter cone, some 25 feet tall, surging to life in the crater below him. "Kīlauea molds the land, belching lava and fumes, hissing, roaring, always transforming. The view I photographed that day doesn't exist anymore."





Elements face off at the park's southern coast. Where lava has plunged into the Pacific, newborn land stacked flow upon frozen flow is chiseled back by the surf. Fallen boulders massaged by blue mist are taken by the sea (right). An ending, a beginning, still going.

THERE IS A PLACE in Hawai'i Volcanoes National Park where Earth's hottest force is finally put to rest: the sea. Miles-long lava tubes—formed when the outer surface of a flow crusts over, creating a conduit for the hot liquid inside—carry the most persistent lava to its end, an explosive, steamy bath.

It's at the water's edge that Pele and sister Nā-maka-o Kaha'i, goddess of the sea, meet in combat. Chain of Craters Road winds down to their coastal battleground, a memorable view even when no lava is flowing. Cool green cliffs called *pali* provide the backdrop for a ten-foot-thick black stage running ten miles along the ocean, frozen lava stretching more than a mile from the pali to the sea. This stage is where life has been swallowed up by flow after flow, but where life will once again take root. The latest revival has already begun: In places, the lava pavement is all but lost among the greens.

"There's something inexplicable down here that demands respect," says Carol Cebula, the park's animal caretaker, as she twists in her saddle to face me. We are riding along the Puna Coast Trail, hugging the Pacific. Carol is a petite, sun-furrowed bundle of muscles, a horse trainer who runs a mule train into the backcountry when maintenance crews need equipment. It's a seven-mile ride to 'Āpua Point, a sliver of a beach where sea turtles nest, one of few oases along this lava desert. If horses can be said to tiptoe, this is how it must look—slow and deliberate, they wend their way over the hoof-twisting, brittle ground. Finally at 'Āpua, we dismount and picnic among white-flowering *naupaka* shrubs with our backs against lava rock walls built to shelter campers from the wind.

"Sometimes the horses spook down here for no obvious reason," Carol says quietly, as if confiding. "Locals say, 'Ah, *obake!* Ghosts! The gods are telling you something!' Maybe. Whatever it is, animals seem to sense this is a spiritual place that deserves reverence. I feel it too."

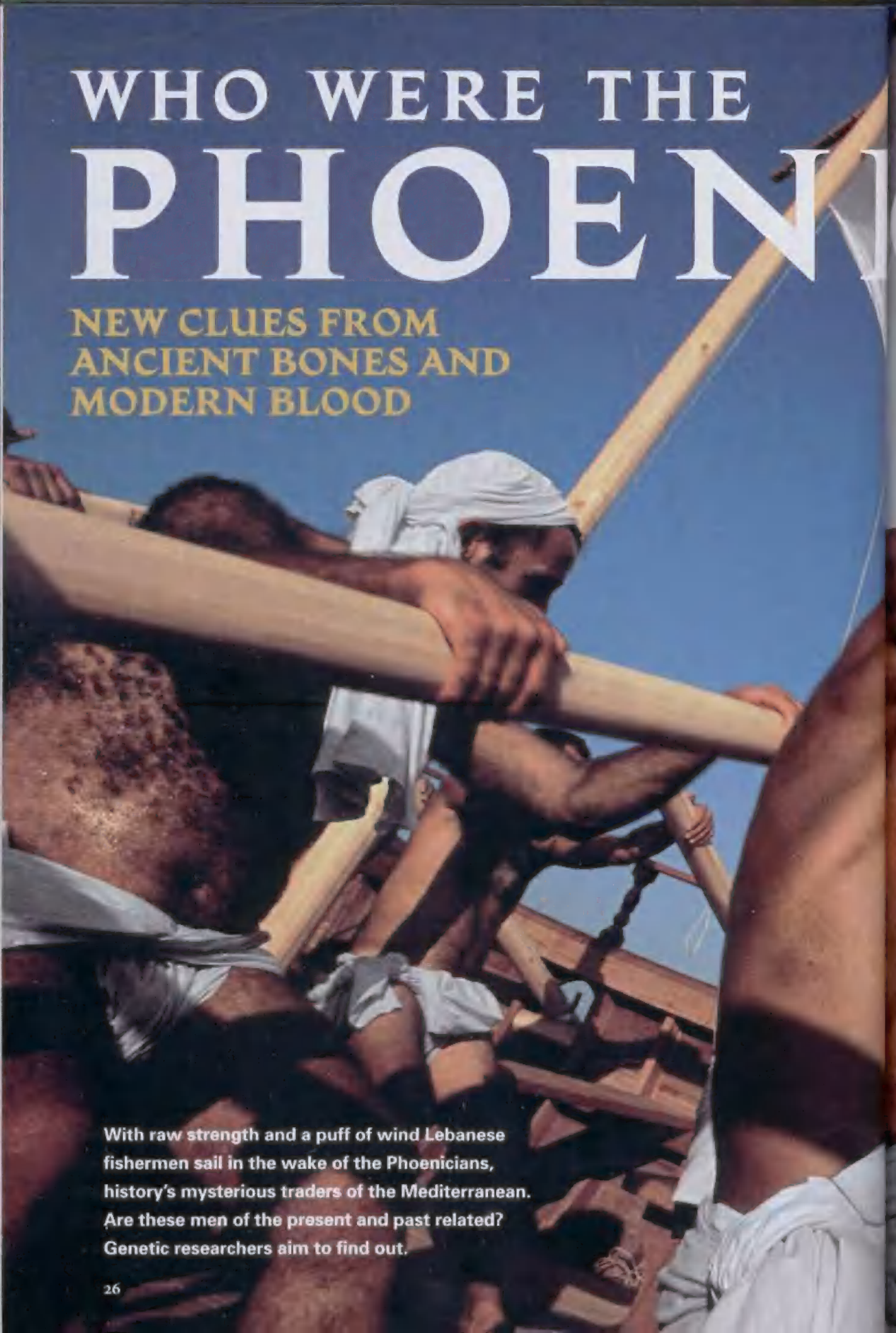
On our return ride along the sea-slapped coast, across decades-old flows stacked 60 feet above the waves, we meet driving rain so violent that the horses turn their backs and refuse to move. Perhaps the gods are once again speaking their minds, down here where the newest land on Earth—sent forth in a hot froth from the planet's deepest well—juts out in an everlasting duel with the sea. But as the storm runs its frenzied course, the wind steals away their message. □

GO VOLCANIC Watch exclusive video of Kīlauea erupting, and download free wallpaper to decorate your desktop with scenes from the park at nationalgeographic.com/magazine/0410. Experience the power of volcanoes in our new giant-screen movie, *Forces of Nature*. For a listing of theaters and a preview go to nationalgeographic.com/forcesofnature.



WHO WERE THE PHOENICIANS

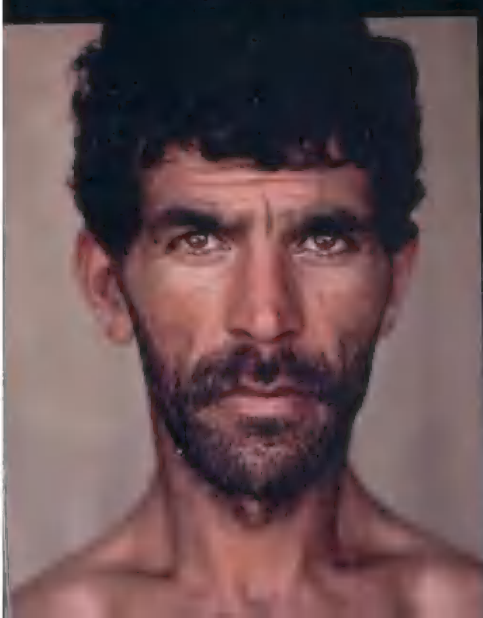
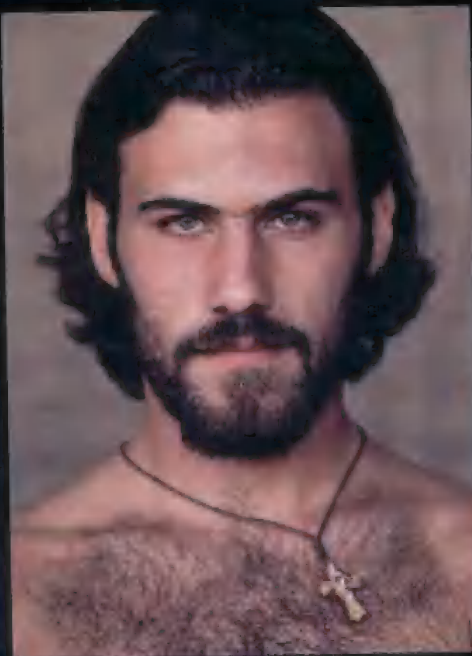
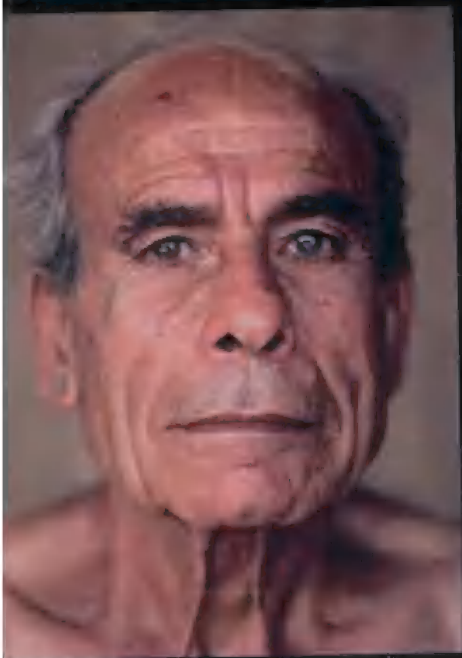
NEW CLUES FROM
ANCIENT BONES AND
MODERN BLOOD

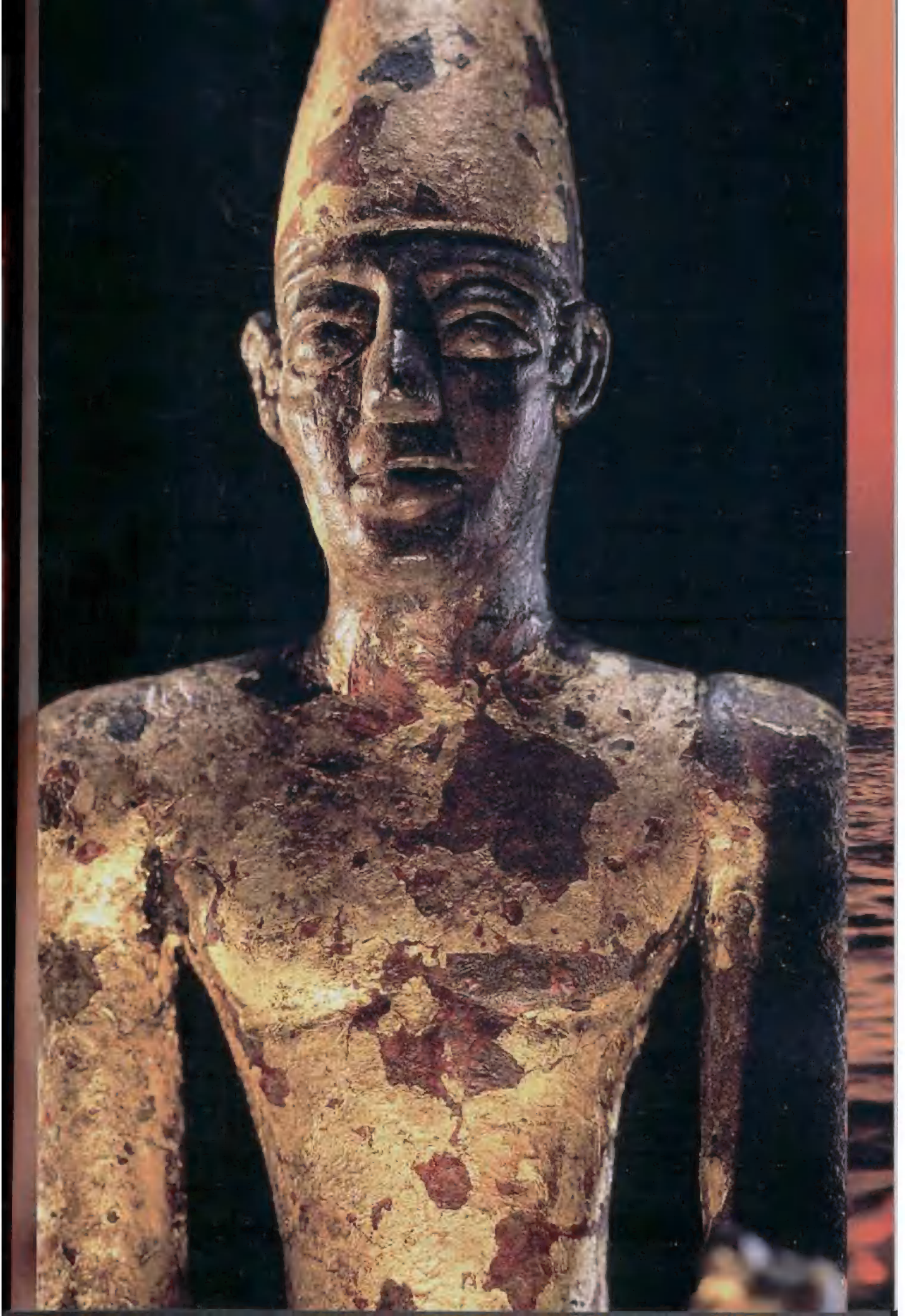


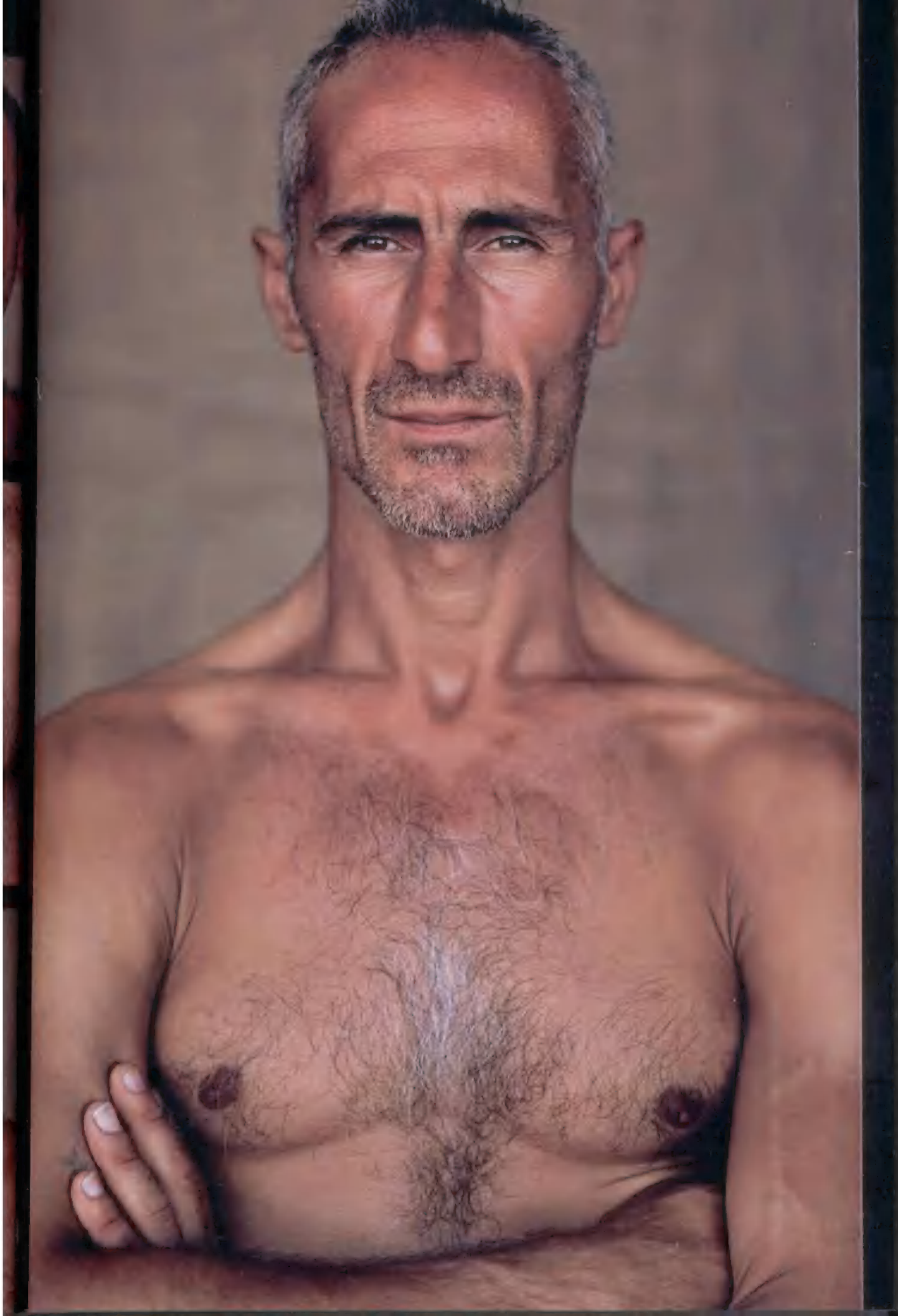
With raw strength and a puff of wind Lebanese fishermen sail in the wake of the Phoenicians, history's mysterious traders of the Mediterranean. Are these men of the present and past related? Genetic researchers aim to find out.

CIANS?









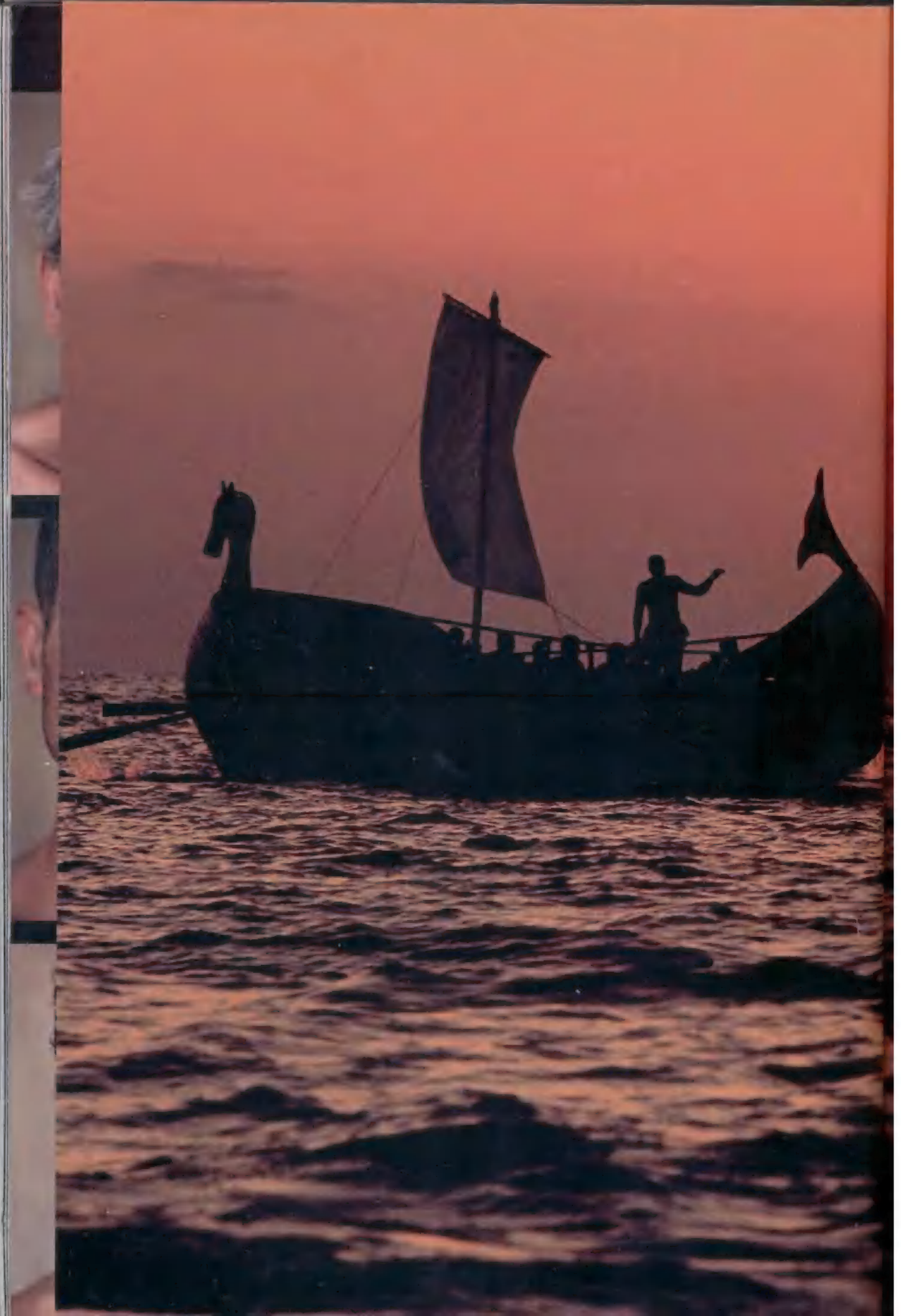
ANCESTRAL BLOOD

TESTING THE GENE POOL

Every day, long before dawn, the fishermen of Tyre, Lebanon, launch their boats as their ancestors have done as far back as anyone can remember. By about nine in the morning they return to port and relax over coffee and games of cards at a seaside café. That's where Spencer Wells, a National Geographic emerging explorer, and his colleague Pierre Zalloua, a geneticist at the American University of Beirut, approached them about taking part in a wide-ranging research project. The goal: to learn whether these fishermen are descended from the Phoenicians who left the first traces of their lives here in the Levant more than 5,000 years ago, and who later spread their culture westward by shipborne commerce. The scientists could find the answer in the inherited genetic patterns of Y chromosomes if the fishermen agreed to donate samples of their blood. Almost all volunteered eagerly—and then stood for portraits, some of which appear here. “Most people are interested in their family history,” says Wells. “And they’re fascinated by the idea that they have a secret in their blood that not only ties them to their grandparents but to people they’ve never met.”

The tests could confirm that men of Tyre—Christians and Muslims alike—are related to the ancient traders. Wells and Zalloua also took samples in other parts of the Phoenician world, where results may reveal the same lineage in areas of former colonies like Sardinia and Malta.







MEN OF THE SEA

A LOST HISTORY

Navigating by the North Star, Phoenician traders sailed on ships similar to a vessel that now tours the harbor of Tyre. Their records, on papyrus, crumbled long ago, leaving these few hints about their lives: artifacts that include a gilded votive statue (left), histories written by their rivals, and the genes they launched into the future.

“**I AM A PHOENICIAN,**” SAYS THE YOUNG MAN, GIVING THE NAME OF A PEOPLE WHO VANISHED FROM HISTORY 2,000 YEARS AGO. “AT LEAST I FEEL LIKE I’M ONE OF THEM. MY RELATIVES HAVE BEEN FISHERMEN AND SAILORS HERE FOR CENTURIES.”

“Good, we can use some real Phoenicians,” says Spencer Wells, an American geneticist, who wraps the young man’s arm in a tourniquet as they sit on the veranda of a restaurant in Byblos, Lebanon, an ancient city of stone on the Mediterranean. The young man, Pierre Abi Saad, has arrived late, eager to participate in an experiment to shed new light on the mysterious Phoenicians. He joins a group of volunteers—fishermen, shopkeepers, and taxi drivers—gathered around tables under the restaurant awning. Wells, a lanky, 34-year-old extrovert, has convinced Saad and the others to give him a sample of their blood.

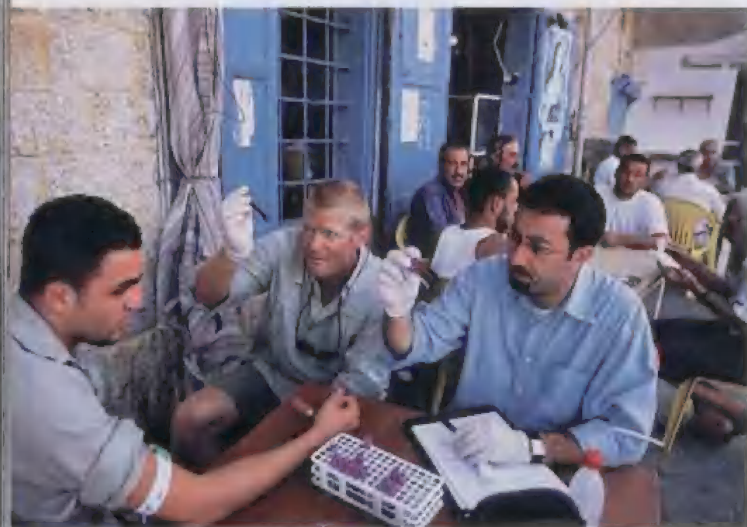
“What will it tell you?” Saad asks.

“Your blood contains DNA, which is like a history book,” Wells replies. “Many different people have come to Byblos over the centuries, and your blood carries traces of their DNA. It’s going to tell us something about your relationships going back thousands of years.”

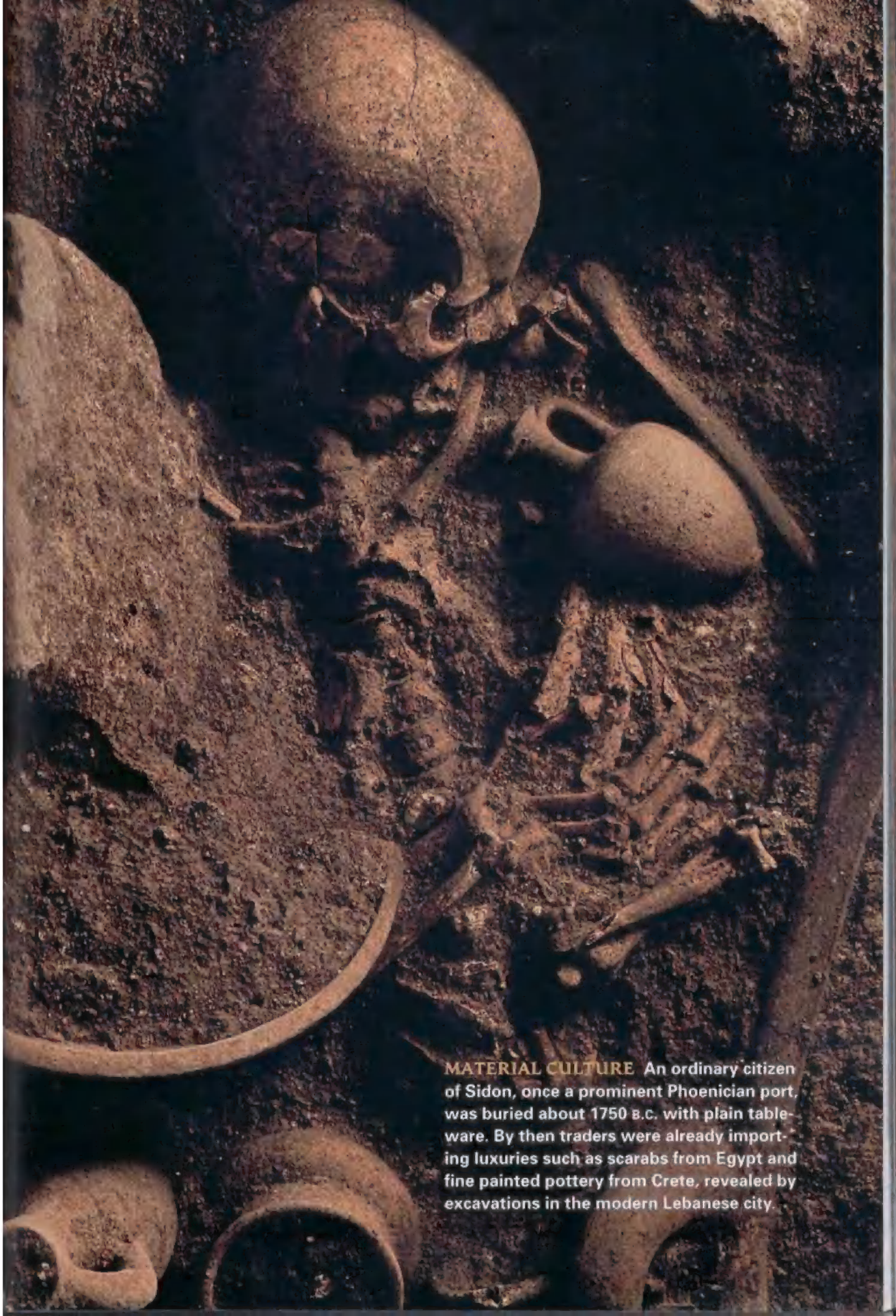
Wells has no doubts about the power of the new genetic techniques he is bringing to our understanding of ancient peoples. Nor does his bespectacled colleague standing beside him on the veranda, Pierre Zalloua, a 37-year-old scientist with a dark goatee and an intense passion for his Lebanese heritage. The two men hope to find new clues to an age-old riddle: Who were the Phoenicians?

Although they’re mentioned frequently in ancient texts as vigorous traders and sailors, we know relatively little about these puzzling people. Historians refer to them as Canaanites when talking about the culture before 1200 B.C. The Greeks called them the *phoinikes*, which means the “red people”—a name that became Phoenicians—after their word for a prized reddish purple cloth the Phoenicians exported. But they would never have called themselves Phoenicians. Rather, they were citizens of the ports from which they set sail, walled cities such as Byblos, Sidon, and Tyre.

The culture later known as Phoenician was flourishing as early as the third millennium B.C. in the Levant, a coastal region now divided primarily between Lebanon, Syria, and Israel. But it wasn’t until around 1100 B.C., after a period of general disorder and social collapse throughout the region, that they emerged as



COLLECTING EVIDENCE At a café near the wharf in Tyre, genetic sleuths Wells and Zalloua check blood samples they’ve drawn from local volunteers. “Some men actually ran to us,” says Zalloua, at right. “They wanted to give blood before the others.”



MATERIAL CULTURE An ordinary citizen of Sidon, once a prominent Phoenician port, was buried about 1750 B.C. with plain tableware. By then traders were already importing luxuries such as scarabs from Egypt and fine painted pottery from Crete, revealed by excavations in the modern Lebanese city.

a significant cultural and political force.

From the ninth to sixth centuries B.C. they dominated the Mediterranean Sea, establishing emporiums and colonies from Cyprus in the east to the Aegean Sea, Italy, North Africa, and Spain in the west. They grew rich trading precious metals from abroad and products such as wine, olive oil, and most notably the timber

MAJESTIC SURVIVOR The symbol of modern Lebanon, a rare mature cedar soars in a mountain reserve where some trees are hundreds of years old. Cedars once covered this land but were cut for their timber, a lucrative export. An alabaster relief (opposite) from the palace of Assyrian King Sargon II recorded the collection of logs about 700 B.C.



from the famous cedars of Lebanon, which forested the mountains that rise steeply from the coast of their homeland.

The armies and peoples that eventually conquered the Phoenicians either destroyed or built over their cities. Their writings, mostly on fragile papyrus, disintegrated—so that we now know the Phoenicians mainly by the biased reports of their enemies. Although the Phoenicians

themselves reportedly had a rich literature, it was totally lost in antiquity. That's ironic, because the Phoenicians actually developed the modern alphabet and spread it through trade to their ports of call.

Acting as cultural middlemen, the Phoenicians disseminated ideas, myths, and knowledge from the powerful Assyrian and Babylonian worlds in what is now Syria and Iraq to their

THEY GREW RICH TRADING PRECIOUS METALS FROM THE WEST AND THE TIMBER FROM THEIR FAMOUS CEDARS.

contacts in the Aegean. Those ideas helped spark a cultural revival in Greece, one which led to the Greeks' Golden Age and hence the birth of Western civilization. The Phoenicians imported so much papyrus from Egypt that the Greeks used their name for the first great Phoenician port, Byblos, to refer to the ancient paper. The name Bible, or "the book," also derives from Byblos.

Today, Spencer Wells says, "Phoenicians have become ghosts, a vanished civilization." Now he and Zalloua hope to use a different alphabet, the molecular letters of DNA, to exhume these ghosts.

The two geneticists became friends in 2000 at Harvard University. Wells was pioneering genetic methods for tracing migrations of ancient peoples by looking at the chromosomes of their living descendants; Zalloua was looking for ways to use science to help heal his country, ravaged by 15 years of civil war between its many religious factions.



HERVE LEWANDOWSKI, LOUVRE

Zalloua was particularly interested in understanding the genetic relationship between the modern Lebanese and their Phoenician ancestors. During the bloody civil war of the 1970s and 1980s, some groups used the name Phoenician as an ideological weapon. Certain Maronites, the dominant Christian sect in Lebanon, claimed a direct ancestry from the Phoenicians, implying that they held a more legitimate historical claim on Lebanon than later immigrants from the Arabian Peninsula. This inflamed many Muslims. The term Phoenician had turned into a code word for Christian rather than Muslim.

It still is. "It's now become taboo to use 'Phoenician' here officially," Zalloua explains. "Go to

the National Museum. You won't see the word anywhere. They label everything simply by its age—early, middle, or late Bronze Age."

Could genetics show that modern Lebanese, both Christians and Muslims, share the same Phoenician heritage? That's one question this project, funded by the National Geographic Society, hopes to resolve. Wells and Zalloua have others.

For one, they want to know whether mysterious groups known as the Sea Peoples might have migrated into Lebanon around 1200 B.C. and mixed with the Canaanites to help create Phoenician culture. Although the Sea Peoples, who may have come from the Aegean, marauded and burned most of the major cities along the coast of the Levant, they apparently spared the Canaanite cities. One leading Phoenician scholar, Maria Eugenia Aubet of Pompeu Fabra University in Barcelona, believes the Canaanites made a deal with the Sea Peoples.

"I think they became friends," she says. "Phoenician material culture shows so many elements from the Sea Peoples. The Phoenicians learned from them how to build harbors, moorings, docks, and piers. The Sea Peoples, like the Phoenicians, were excellent navigators—and they knew the routes west to the rich sources of metals."

Spencer Wells suspects that the Sea Peoples also introduced their genes into the DNA of the Canaanites.

"Was there a mass migration of Sea Peoples?" Wells asks, as he and Zalloua take turns collecting DNA samples in Byblos. "Did it help create a Phoenician genetic type? We have the tools now to answer those questions."

Wells and Zalloua are seeking markers—mutations that arose in Phoenician times that can still be found in blood today. The markers would be extremely subtle, changes in a few letters out of three billion in our book of genetic instructions. But they would be enough to identify descendants of Phoenicians. Markers can be found at specific places on the Y chromosome, the threadlike package of genes located in the nucleus of almost every cell in males. Two chromosomes, the X and the Y, determine sex. Females have two X's; males have one X and one Y. The Y contains the genes that create maleness.

The Y chromosome, uniquely, is passed from father to son with no (Continued on page 42)



2 TRADE NETWORK

While searching in the Mediterranean—and beyond—for resources such as silver, the Phoenicians found markets for their own products.

3 COLONIES

Ships on long trade expeditions laid over in western outposts. Settlers in North Africa spoke a Phoenician dialect called Punic.

3200 B.C.

As early as the predynastic period, Egyptians imported prized cedars from Phoenician traders of Byblos.

2500 B.C.

Major ports on the Phoenician coast—Byblos, Sidon, Tyre, and Beirut—emerged as independent city-states.

1200 B.C.

A phonetic alphabet of 22 consonants developed, along with a distinct Phoenician language and culture.

877 B.C.

Assyrian King Ashurnasirpal II visited the cities of Phoenicia, which soon began to send gifts as tribute to his empire.

814 B.C.

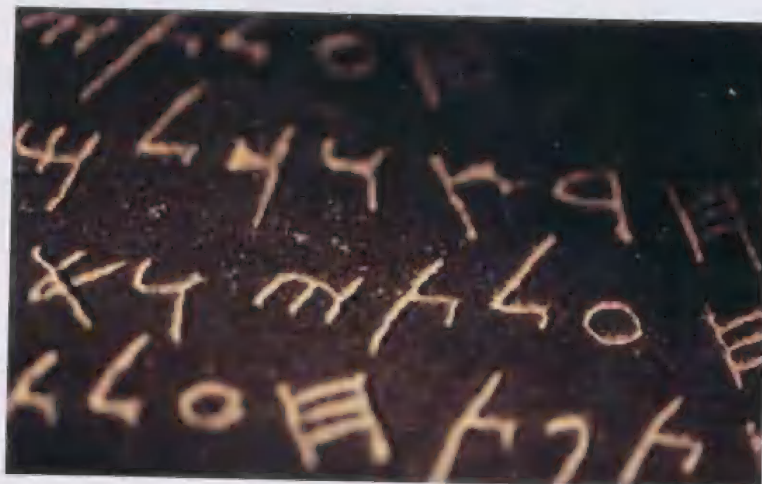
Expanding westward, Tyre founded Carthage—Qart-hadasht, or “new city”—an early Phoenician colony in Africa.

573 B.C.

After his predecessor defeated Assyria, King Nebuchadnezzar II of Babylonia besieged and gained control of Tyre.

MERCHANT MARINERS

Rooted in the Canaanite culture of the eastern Mediterranean coast, the Phoenicians became skillful traders and sailors whose colonies and ports of call stretched to the Atlantic. They remained a loosely affiliated group of cities dominated by powerful neighbors until Carthage finally forged an empire.



DAVID McLAIN (BOTH)



HOME PORTS

The Phoenicians exported their own raw materials and crafts and transported goods produced in other Mediterranean regions.

MAP KEY

- Shipwreck
- Trade product
- Phoenician-era settlement; present-day names in parentheses



GOLD MASK: FRANKS RAUX, LOUVRE; GLASS AMULET: BARDO MUSEUM, TUNISIA; CLAY FACE: MUSEO DE CADIZ, SPAIN

ART BY RICHARD SCHLECHT NATIONAL GEOGRAPHIC MAPS

539 B.C.

Persian Emperor Cyrus the Great captured Babylon, and Phoenicia became a province in his vast empire.

332 B.C.

Alexander the Great crushed Tyre, the only Phoenician city to offer serious resistance to his conquest of Persia.

264 B.C.

The First Punic War began as Carthage and Rome fought for control of Sicily. A second war started in 218 B.C. in Italy.

146 B.C.

Rome burned Carthage, ending the Third Punic War and annihilating the last major center of Phoenician culture.

Phoenician city of Tyre



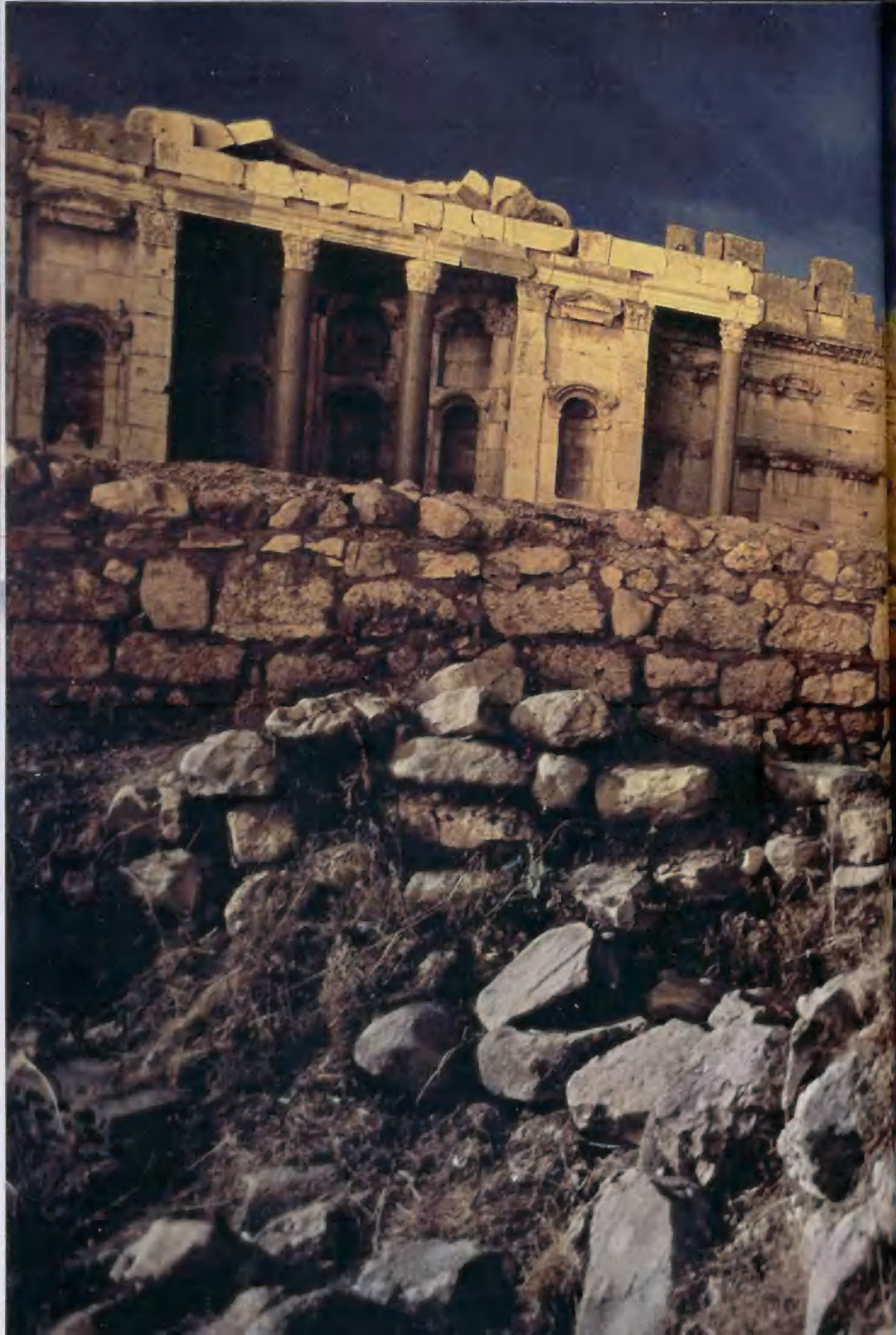
Alexander's causeway was built in 332 B.C. See art pages 44-5

Scale varies in this perspective; Phoenician city is two-thirds of a mile from mainland.

With mountains to their backs and the sea spreading before them, the Phoenicians left a line of settlements along what is now the coast of Lebanon, Syria, and Israel (inset, above). Tyre, once the most powerful of their cities, possessed features that

Phoenician colonists sought again and again when settling on foreign shores: a defensible island, a protected anchorage, and easy access to agricultural fields on the mainland (above). Sidon, another great port, provided evidence of a revolutionary

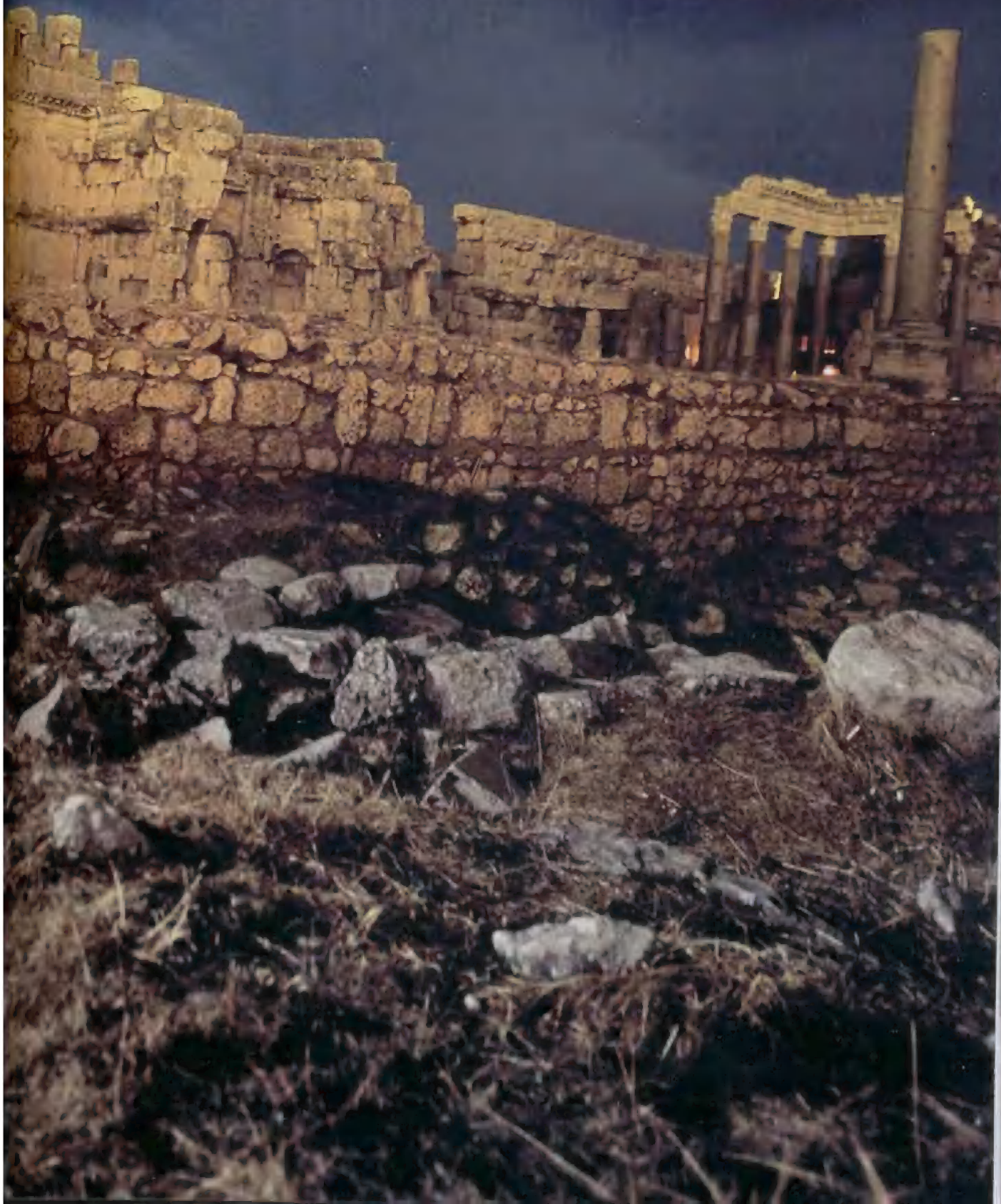
Phoenician development: the world's earliest alphabet. In the sixth century B.C. a king named Tabnit obtained an Egyptian sarcophagus (left) and added an inscription in Phoenician (far left) so he could use it himself.



HOMELAND

BURIED RUINS

Glowing in the sunset, a Roman temple at Baalbek, Lebanon, outshines the much older structures uncovered in the foreground. Ancestors of the Phoenician traders may have lived here as early as the third millennium B.C. But, as at many sites, interest in preserving the overlying buildings has hindered investigation of the early levels.



input from the mother. Changes in its DNA are preserved generation after generation, so the male descendants of Phoenicians would inherit ancient patterns of mutations indefinitely.

Genetic analysis has traced all modern males back to a common Y-chromosome ancestor, nicknamed Adam, who lived in Africa around 60,000 years ago and whose descendants spread throughout the world. Lebanon has also seen many migrations since Phoenician times, notably from the Arabian Peninsula during the rise of Islam and from Europe during the Crusades.

"The genetic inputs from those migrations are very clear," says Zalloua, including those of northern invaders. "There are villages in Lebanon that still have a high percentage of fair-skinned blonds."

Identifying Phoenician markers takes sophisticated comparisons of the DNA from thousands of men like those of Byblos. But Byblos is just one stop on Wells's and Zalloua's sampling campaign—a campaign that will take many months to show results.

Genetic researchers aren't the only ones seeking new clues to the identity of the Phoenicians. Scientists from Lebanon to North Africa to Spain are finding other evidence through traditional archaeology. Lebanese archaeologist Claude Doumet-Serhal, for one, is leading a team systematically exploring for the first time the port of Sidon, another major Phoenician city. The heart of that ancient port lies beneath a thriving modern town, out of archaeology's reach until a 19th-century school was torn down. In 1998 Doumet-Serhal's team, funded by the British Museum and a consortium of sponsors, began boring into the center of the old city.

"We are part of a rebirth of archaeology in Lebanon after 15 years of civil war," she says, descending into the excavation, which stretches for the length of a football field amid a bazaar of old buildings. She moves excitedly through the dig, a series of trenches where clusters of professional and student archaeologists scrape, pick,

NATURAL COLOR Dyed by a rediscovered ancient process, luxurious silk recalls the coveted purple fabrics that the Phoenicians produced and exported. Only the most privileged customers could afford such finery. To make one precious ounce of the dye took the glands of thousands of murex mollusks, whose shells still litter old work sites.



and chisel back through 5,000 years.

The past three seasons have brought a bonanza of discoveries. She stops where team members are scraping out the bones of a burial from the 20th century B.C. This body, along with more than 30 others, was placed in an enigmatic layer of sand as thick as four feet. The layer dates from shortly after 2000 B.C. Puzzled by this deposit,

THE GREEKS CALLED THEM "PHOINIKES" FOR A PURPLE FABRIC THEY EXPORTED—A NAME THAT BECAME PHOENICIANS.

Doumet-Serhal had the grains analyzed and found that they came from a nearby dune.

"The ancient Sidonians sifted the sand and brought it here manually," she says. "It's bizarre. They went to a lot of trouble to make this layer." Was this a custom brought to Sidon by a wave of invaders? The evidence doesn't say. The bodies initially placed in the layer were those of elite warriors. Their graves were constructed with bricks and adorned with elegantly crafted weapons. Later regular citizens, including children whose bodies were placed in clay pots, were also buried in this layer.

Researchers studying the weapons of the warriors have gleaned important clues from the metal. Analysis of isotopes indicates that the ores used to make the weapons came from mines in modern Turkey, Cyprus, or Syria, evidence that the Sidonians were already engaged in a flourishing metals trade in the eastern Mediterranean by 1950 B.C.



Across the Mediterranean in Spain, the timbers of two seventh-century B.C. Phoenician shipwrecks discovered in the Bay of Mazarrón near Cartagena are providing a different type of information—about how Phoenicians constructed their ships. "For the first time we have the actual ships of the Phoenicians," says Ivan Negueruela of Spain's National Museum for Maritime Archaeology. "Their ships are the key to their colonizing, the way they traveled the Mediterranean. We can't understand them without their ships. Now we can see how they actually cut the wood, how they joined it."

The ships reveal that the Phoenicians used

mortise-and-tenon joints, giving their boats more strength than earlier boats, which were basically made of planks sewn together. The team discovered a wooden anchor that had been filled with lead, apparently a novel invention of the Phoenicians. Researchers also found intact Phoenician knots, amphorae the crew used to store trade goods, and mills they used to grind wheat. The hulls of the boats were lined with brush, the Phoenician version of bubble wrap, to keep their cargo of lead ingots from shifting and damaging the hulls. That meant the Mazarrón ships, measuring about 25 feet in length, were working boats, rather than the impressive galleys historical sources say the Phoenicians sailed.

The Phoenicians may have used these smaller boats to ferry cargo to galleys waiting offshore. The boats seemed too small to have made the open-sea journeys back to Phoenician home ports. But Phoenician seafaring skills and larger vessels let them travel into the Atlantic and trade along the African coast.

When did they first reach the Atlantic? Scholars debate the possibilities. Classical texts suggest they had established a colony beyond the Strait of Gibraltar at Cádiz by 1100 B.C., but no archaeological remains can be dated earlier than the eighth century B.C. Spanish archaeologist Francisco Giles, a veteran explorer of ancient ruins near the coast of Andalusia, thinks a painting in a rock-shelter in the mountains overlooking the strait may answer the question. The painting, discovered in a remote part of a cork tree forest, stylistically dates to the end of the second millennium B.C. and portrays a sailing ship surrounded by a group of stick figures.

"This represents contact," says Giles. "The local people were painting something they had never seen before."

"The ships were most likely Phoenician, because it was the Phoenicians who settled here," says his collaborator, Clive Finlayson of the Gibraltar Museum.

And settle the Phoenicians did. By the eighth century B.C. they had established communities along the entire southern coast of Spain to reap the harvest of the land and the riches of the Iberian mines.

"They created the concept of colonization," says Giles. "They brought to the Iberians all the products of cultures to the east. In return the Phoenicians got the Iberians' natural resources."

CRUSHING DEFEAT Fresh from victories over the Persians, Alexander the Great took on Tyre, a Persian vassal, in 332 B.C. To storm the island fortress, he built a causeway and two siege towers. Alarmed, the Tyrians launched a boat with blazing cauldrons to torch the attackers—but to no avail. After a seven-month assault, Alexander triumphed.

The Phoenicians would have brought something else to Spain—their Y chromosomes. Spencer Wells and Pierre Zalloua want to search for Phoenician markers in living Spaniards. But to help them identify those markers, they are first taking blood samples closer to the Phoenician homeland.

A steep hill known as the Byrsa rises along the Tunisian coast of North Africa, overlooking the residences of modern Carthage, the most affluent suburb of Tunis, the capital. In the distance peninsulas and promontories stretch into the blue sea. On a sunny October morning Wells and Zalloua ascend the Byrsa and peer down on the excavated streets of one of the earliest colonies, and certainly the grandest, established by the Phoenicians.

Founded by the city of Tyre as early as 814 B.C., Carthage emerged as a formidable power itself about 300 years later, after a 13-year siege by the Babylonians depleted Tyre's resources. Eventually Carthage dominated the western Mediterranean and gradually developed its own culture, known as Punic to the Romans. As Rome emerged as a central Mediterranean power in the third century B.C., it clashed with Carthage in a series of confrontations known as the Punic Wars. The famous Carthaginian general Hannibal nearly conquered Rome, but in 202 B.C. he was defeated near Carthage. In 146 B.C. Rome burned and destroyed this last major Phoenician city.

Wells and Zalloua have come to Carthage to seek help from Tunisian colleagues. They need local DNA to find what's left of Phoenician chromosomes here. That's a complex job: A lot of Middle Eastern people, as well as Africans and Romans, have left their genes in Carthage over the centuries. Calculating when a particular set of chromosomes emerged is difficult, but Wells and Zalloua say they can date mutations relatively accurately.



Certain short sections of junk DNA, called microsatellites, mutate much more rapidly than the longer sequences. They nevertheless mutate at a constant rate, providing a clock that lets geneticists date how old a particular form of a chromosome is. For example, Wells knows he comes from a western European Y-chromosome type called M173. Microsatellites indicate that the man who gave rise to M173, and hence to most western Europeans, lived about 30,000 years ago. Zalloua, on the other hand, has an M20 lineage, which originated in the area of Iran around the same time and is mostly found today in India. Less than 2 percent of Lebanese men have that type.

Most Middle Eastern men belong to M89 and M172. M89s date back to a major migration



ART BY TOM FREEMAN

out of Africa around 45,000 years ago; M172s date back to the dawn of agriculture about 12,000 years ago. Phoenician markers should be carried on either of these types. Most men living in the area surrounding Carthage before the Phoenicians arrived should probably have carried variations of the M96, which is the aboriginal type in North and West Africa. So if Wells and Zalloua find in Tunisia a significant number of M172s and M89s, the Middle Eastern Y chromosomes, that could suggest a link to the Phoenicians.

“If we can find markers here that could only have originated in the Middle East during the Phoenician age, we can assume they were brought by the Phoenicians,” says Wells.

While Wells and Zalloua are taking samples

in Tunisia, a Dutch archaeologist is piecing together a different portrait of the Phoenician colonization at Carthage. Roald Docter, a professor at Ghent University, is part of a Tunisian-Belgian team that recently excavated the cemetery of the first generation of Phoenicians to settle Carthage.

His site, like many archaeological digs, appears unspectacular at first glimpse. Next to a supermarket in an urban zone, it is overgrown with weeds and pocked with heaps of dirt, plastic bottles, and other trash. Last season’s trenches have slumped due to recent heavy rains.

“This looked very neat a month ago,” he says, walking to the edge of a deep muddy trench. He points to a round pit in the yellowish bedrock below. About three feet across, it is one of nine

his Tunisian colleagues have located. They found pieces of funerary pots as well as fragments of bone—the bones of the first settlers.

This site, called Bir Massouda, and an adjacent zone that Docter also helped excavate with a University of Hamburg team, shows how the Phoenicians changed and reorganized their colony as it grew into a city. During the first part of the eighth century B.C. the homes were widely spaced along a dirt path, which was later lined with cobbles. Then, as more settlers arrived, the city filled in and became more densely urban. Remnants of elephant tusks indicate that merchant shops were trading in ivory.

Around 675 B.C. another influx of Phoenicians surged into Carthage, bringing a new style of four-room house typical of the Levant. Apparently, a growing menace from the Assyrians had encouraged many Tyrians to emigrate from the homeland.

“If a group of Assyrian soldiers arrives every year, rapes your wife, and takes your money, you might head west too,” says Docter.

During this period the residents moved the original cemetery, replacing it with a huge metalworking site. Docter’s team has found remnants of a surprisingly advanced technology. CT scans of ancient bellows reveal they contained intake valves to regulate airflow into the hearths and raise the temperature of the hot iron.

The Carthaginians were already strengthening their weapons with a metallurgical technology similar to the Bessemer process, which was not developed until the 19th century. Metallurgist Hans Koens of the University of Amsterdam discovered that the Carthaginians in antiquity were adding large amounts of calcium to the metal, a process that chemically strengthens iron.

This past season Docter’s research team located the source of that calcium—the shells of the same mollusk, the murex, which yielded the purple dye that gave the Phoenicians their name. Huge amounts of crushed shells, along with basalt grinders and grindstones cover the metalworking site.

But at the end of the fifth century B.C. the

metalworking region succumbed to another population surge. As their city exploded in size, the residents built houses over the hearths. The pits at Bir Massouda are revealing the foundations of those homes. The residents by then belonged to a new society, as distinct from its Phoenician founders as North Americans are today from their 17th-century colonial ancestors. They had embraced new variants of the Tyrian gods. But the Carthaginians always retained a Phoenician style. They continued their forefathers’ wanderlust with voyages around Africa and perhaps farther.

Although the Carthaginians ruled the western Mediterranean for centuries, ultimately they could not resist the power of Rome. Their final hours were gruesome.

“Fire spread and carried everything down,” wrote Appian, describing how Roman soldiers finally breached the walls in 146 B.C. and torched the city, pulling down its buildings on top of the residents hiding within.

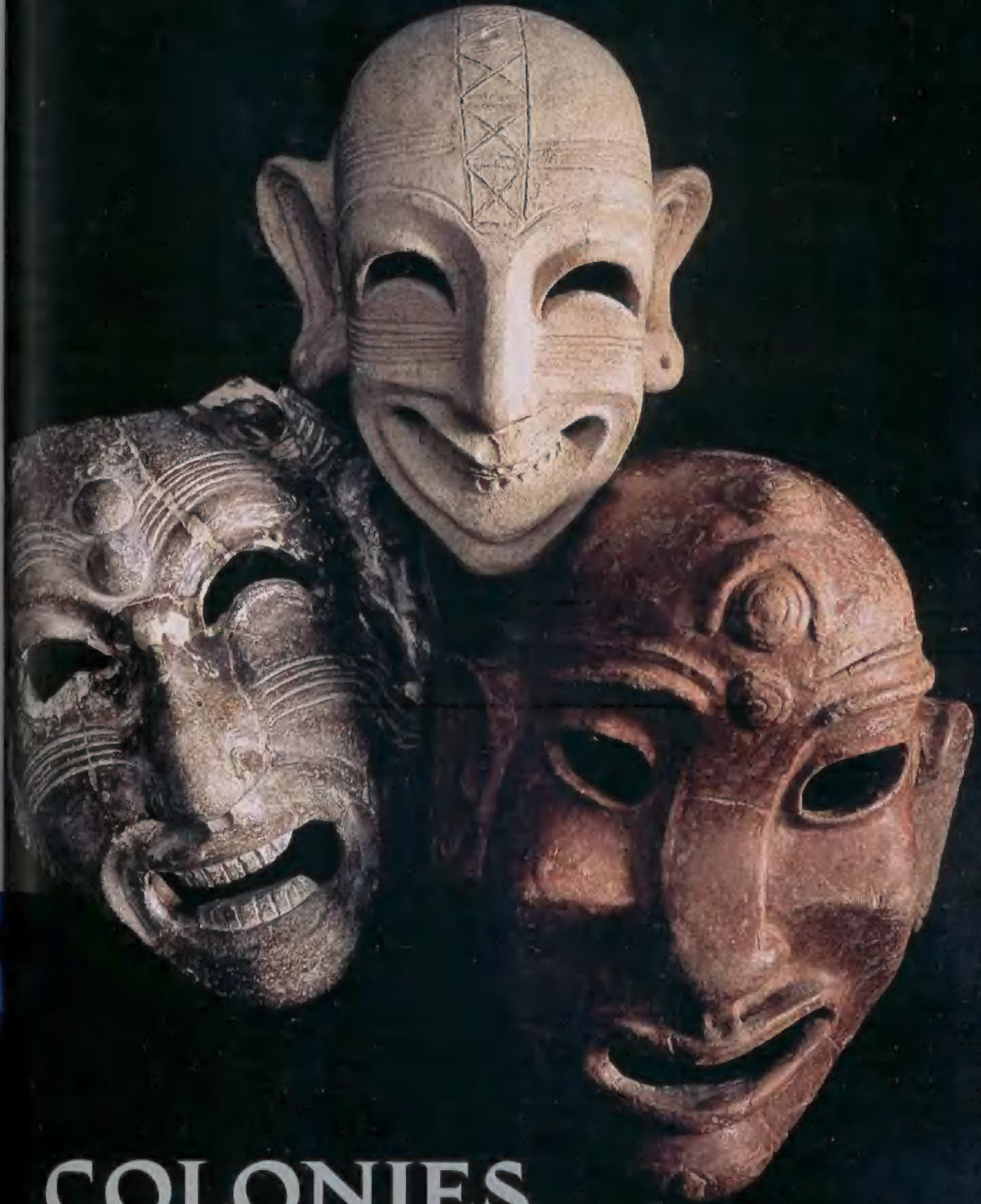
Archaeologist Docter has found chilling evidence of that conflagration. He points down at the mosaic floor of a house the team uncovered. A layer of black char covers it.

“That’s from the fires of 146 B.C.” says Docter.

When Carthage fell, the people were enslaved and they disappeared, explains Tunisian archaeologist Nejib Ben Lazreg. “This doesn’t mean the culture disappeared. It had become so rooted in North Africa that it was centuries before people



CARTHAGE DOMINATED THE WESTERN MEDITERRANEAN AND DEVELOPED ITS OWN CULTURE, KNOWN AS PUNIC.



COLONIES

A SHARED CULTURE

Terra-cotta caricatures, almost life-size, were buried in tombs in Carthage, probably to protect the deceased from evil. Carthage exported this ancient Phoenician tradition from the Punic coast in North Africa (left) to settlements in Sicily, Sardinia, and Spain.

FIRM FOOTING Sacked by the Romans when they invaded North Africa in 256 B.C., Kerkouane preserves a mosaic floor with a symbol likely invoking prosperity. Such everyday remains provide a picture of the Phoenicians that genetics promises to flesh out.

abandoned the language. By A.D. 193 Rome had an emperor from North Africa, Septimius Severus, and he spoke with a strong Phoenician accent. That was the revenge of Carthage.”

The Phoenicians also persisted genetically. Early this year, as Wells and Zalloua complete their DNA sampling, they shift their search from collecting samples to analyzing the thousands of plastic vials of DNA they have assembled at Zalloua’s lab at the American University of Beirut.

“All this is concentrated DNA,” says Zalloua, holding a box of vials from Tunisia. He lifts out a vial labeled DN44. “We’ll put a little of this on a glass plate with appropriate enzymes to isolate a specific region of the Y-chromosome DNA we want to analyze. We have lots of data to digest.”

He prints a chart of their Lebanese data and runs his finger down a list of analyzed samples. Most, but not all, samples indicate Middle Eastern or African origins.

“Ah, there’s a Spencer—a European,” says Zalloua, pointing to an M173. “That man might be descended from a crusader.”

Over the next few months, the analysis of both Lebanese and Tunisian samples proceeds. By the end of the summer, Wells and Zalloua have come to some conclusions.

Who were the Phoenicians? The answer deciphered from their vials of DNA both pleases and frustrates the scientists. Perhaps most significantly, their data show that modern Lebanese people share a genetic identity going back thousands of years.

“The Phoenicians were the Canaanites—and the ancestors of today’s Lebanese,” says Wells.

That result extinguishes Wells’ theory that



the migrating Sea Peoples interbred with the Canaanites to create the Phoenician culture.

“The Sea Peoples apparently had no significant genetic impact on populations in the Levant,” he explains. “The people living today along the coast where the Sea Peoples would have interbred have very similar Y-chromosome patterns to those living inland. They are basically all one people.”

That result delights Zalloua; it supports his belief that both Muslim and Christian Lebanese

THE FINAL HOURS WERE GRUESOME, AS ROMAN SOLDIERS PULLED DOWN BUILDINGS ON TOP OF THE RESIDENTS.



populations share an ancient genetic heritage.

“Maybe now we can finally put some of our internal struggles to rest,” he says.

The data from Tunisia also help redefine the legacy of the Phoenicians.

“They left only a small impact in North Africa,” Wells says. “No more than 20 percent of the men we sampled had Y chromosomes that originated in the Middle East. Most carried the aboriginal North African M96 pattern.”

That influx from the Middle East could have come in three waves: the arrival of farming in North Africa 10,000 years ago, the Phoenicians, and the Islamic expansion 1,300 years ago. Microsatellites will let the researchers estimate when people bearing those markers arrived. Even if they all turned out to be of Phoenician age,

the impact on local people was relatively small.

“Apparently, they didn’t interbreed much,” Wells says. “They seem to have stuck mostly to themselves.” Since they left so few markers, Wells must modify his plan to track Phoenician migrations around the Mediterranean—and perhaps even farther.

“They were a slippery people,” he says. “They came. They traded. They left. I guess that only adds to their mystery.”

And so—for the time being, at least—the Phoenicians remain glorious ghosts. □

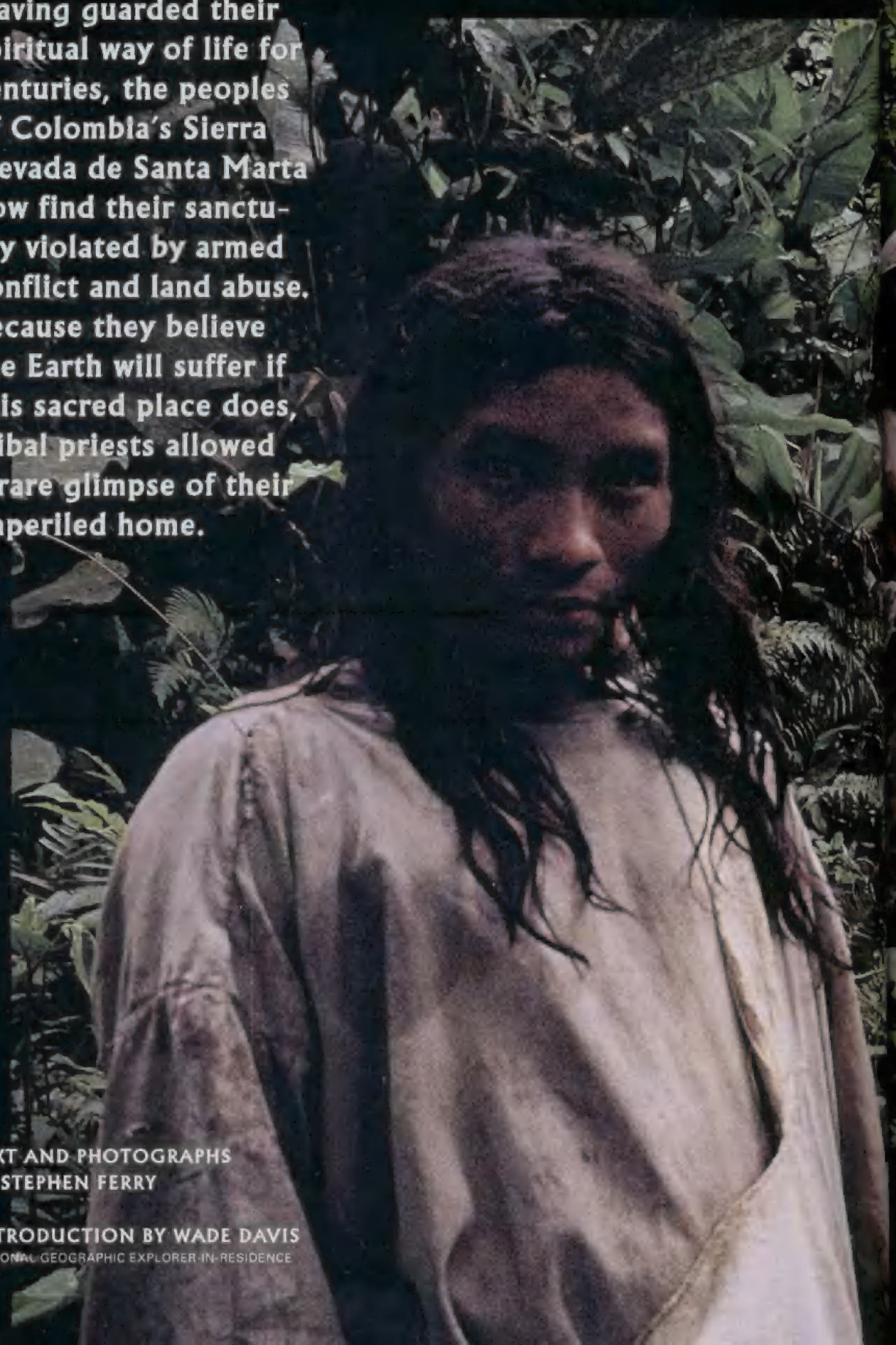
LATEST RESULTS Get an update on Spencer Wells’s and Pierre Zalloua’s DNA study, then check out online-exclusive images by Robert Clark and a listing of related websites at nationalgeographic.com/magazine/0410.

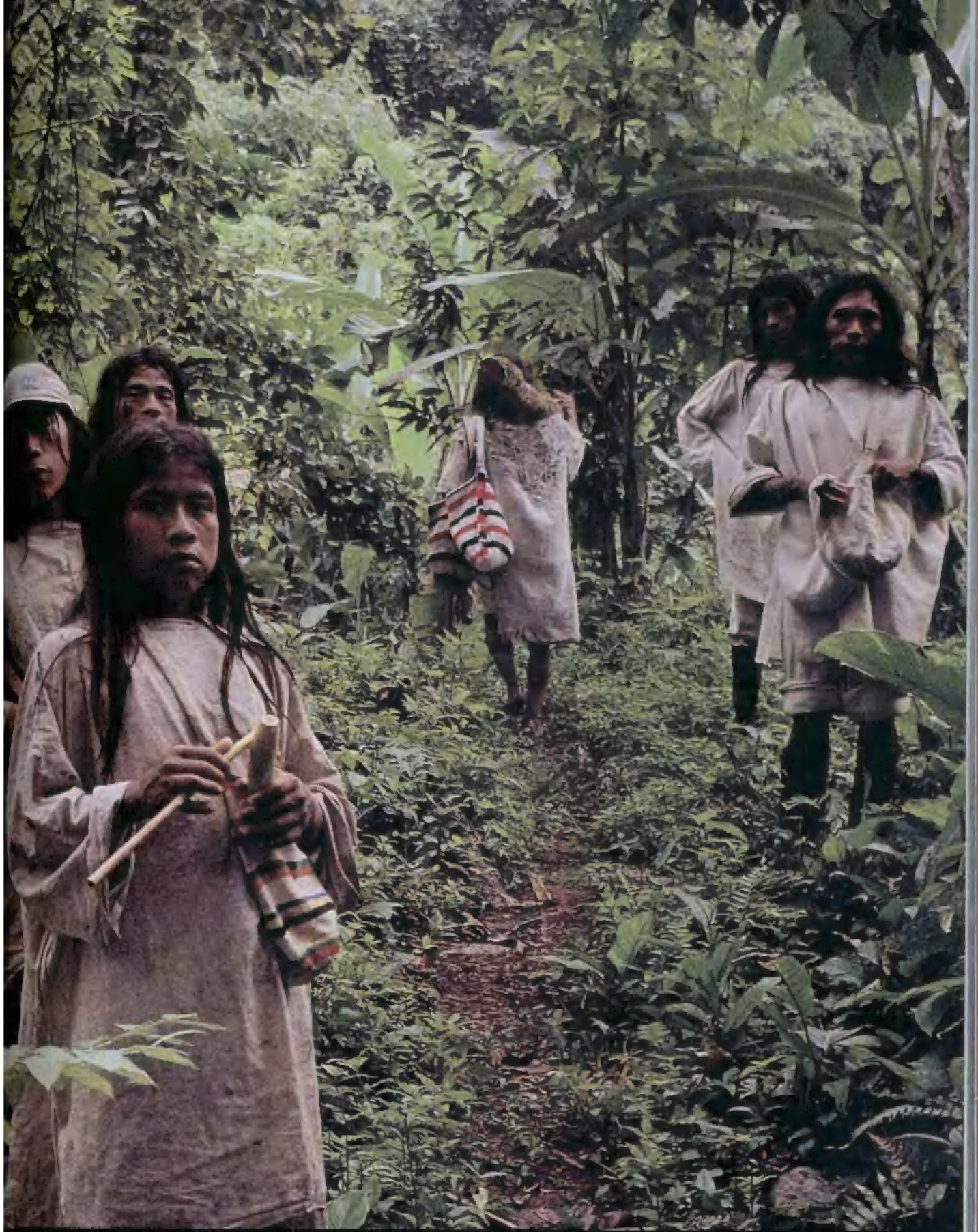
Keepers of

Having guarded their spiritual way of life for centuries, the peoples of Colombia's Sierra Nevada de Santa Marta now find their sanctuary violated by armed conflict and land abuse. Because they believe the Earth will suffer if this sacred place does, tribal priests allowed a rare glimpse of their imperiled home.

TEXT AND PHOTOGRAPHS
BY STEPHEN FERRY

INTRODUCTION BY WADE DAVIS
NATIONAL GEOGRAPHIC EXPLORER-IN-RESIDENCE





the world



INTRUSION

Though the traditional peoples of the Sierra Nevada—the Wiwa, Kogi, and Arhuaco—insist they want no part of Colombia's civil conflict, the combatants do not respect their neutrality. One day, an army helicopter dropped off some of the 2,000 soldiers who were deployed in hot pursuit of a guerrilla column thought to be active near the



Kogi village of Uluezhi. After firing questions at the Indians, seemingly oblivious of the fact that many don't speak Spanish, the soldiers pitched camp in Uluezhi, some eventually making off with ceremonial objects. "All sides—guerrillas, army, and paramilitaries—are the same," said a Kogi man. "They say they fight to defend the Indian, only to turn around and try to destroy us."

In a bloodstained continent, the Indians of the Sierra Nevada de Santa Marta were never truly vanquished by the Spaniards. Descendants of an ancient South American civilization called the Tayrona and numbering perhaps 45,000 today, the Kogi, Arhuaco, and Wiwa peoples fled death and pestilence four centuries ago, seeking refuge in a mountain paradise, whose peaks soar more than 18,000 feet above the Caribbean coast of Colombia. In the wake of the conquest they developed an utterly new dream of the Earth, a revelation that balanced the baroque potential of the human mind and spirit with all the forces of nature.

Separated by language but closely related by myth and memory, they share a common way of life and the same fundamental religious convictions. (A fourth group, the Kankuamo, also found protection in the Sierra Nevada, but they have now become more assimilated into Colombian society.) To this day the Kogi, Arhuaco, and Wiwa remain true to their ancient laws—the moral, ecological, and spiritual dictates of the primordial creator, a force they identify as the Mother—and are still led and inspired by a ritual priesthood. In an arduous process of initiation that can take up to 18 years, young acolytes are taught the values of their society, among them the notion that their spiritual work alone maintains the cosmic (or as we might say, ecological) balance.

When the priests, or Mamas, speak, they immediately reveal that their reference points are not of our world. They refer to the Spanish conquest as if it were a recent event. They talk openly of the force of creation, or *Se*, the spiritual core of all existence, and *aluna*, human thought, soul, and imagination. What is important, what has ultimate value, is not what is



measured and seen but what exists in the many realms of meanings and connections that lie beneath the tangible realities of the world, linking all things. The nine-layered universe of their cosmology, the nine-tiered temple where they gather, the nine months a child spends in its mother's womb are all expressions of creation, and each reflects and informs the other. A hill can also be a house, the mountains a model of the cosmos. The white hats worn by Arhuaco men also symbolize the snowfields of the sacred peaks. The hairs on a person's body echo the forest trees that cover the mountain flanks. Every element of nature is imbued with higher significance, so that even the most modest of creatures can be seen as a teacher, and every feature of the world mirrors the whole.

In this cosmic scheme people are central, for it is most clearly through the human heart and imagination that ultimate understanding may become manifest. For the people of the Sierra Nevada, the nature of their beliefs imbues them

with a special responsibility. They call themselves the Elder Brothers, true guardians of the planet, and they consider their mountain to be the Heart of the World. We outsiders who threaten the Earth through our ignorance of the sacred law are thought of as the Younger Brothers.

In many ways the 8,000-square-mile homeland of the Kogi, Arhuaco, and Wiwa is indeed a microcosm of the world and thus its symbolic heart. Drained by more than 30 river basins, the massif of the Sierra Nevada de Santa Marta rises abruptly from sea to summit ice at 18,947 feet—the highest coastal mountain formation on the planet. As an island unto itself, the massif and its surroundings encompass a stunning diversity of ecosystems. There are mangrove swamps, tropical rain forests and open woodlands, dry scrublands and deserts—and soaring above all in the clouds and blowing rain, the alpine tundra and snowy peaks where the priests go to carry out sacred rituals and ceremonies. They see their spiritual work as directed toward achieving balance and harmony among all facets of creation. This, the Indians maintain, is exactly as the Mother intended.

According to myth, the mountains came into existence when the Earth was spun on an enormous spindle, and the nine layers of the universe conceived. Two lengths of thread were crossed to establish the four points that represent each indigenous group and to support the base of the massif, henceforth declared to be the homeland of the Elder Brothers.

This act of creation is never forgotten. The

loom, the act of spinning, the notion of a community woven into the fabric of a landscape are for the people of the Sierra Nevada vital and living metaphors that consciously guide and direct their lives. They survive as farmers, and in order to exploit diverse ecological zones, they are constantly on the move, harvesting manioc, corn, sugarcane, and pineapples in the hot lowlands, climbing higher to plant potatoes and onions and to graze cattle and gather thatch. They refer to these periodic wanderings as weavings, with the notion that over time

a community lays down a protective cloak upon the Earth.

Over centuries the peoples of the Sierra Nevada have developed a unique science of the mind, one so diametrically in contrast to our own Aristotelian worldview, so divorced from our way of thinking, that it is as difficult for us to grasp as it is for them to comprehend the decisions and values that drive our culture. Thus they have watched in horror as outsiders have violated the Heart of the World, tearing down the forests to establish banana and oil palm plantations and now also plots on which to grow coca



Feeling special for a day, a Kogi boy wears a traditional priest's hat. The shape symbolizes the Sierra Nevada's snowy peaks.

for the illicit production of cocaine. Leftist guerrillas and right-wing paramilitaries have entered the Sierra Nevada and drawn the Indians into the political turmoil that is modern Colombia.

For the Kogi, Arhuaco, and Wiwa, this danger from below is echoed by a threat from on high. The snows and glaciers of the Sierra Nevada are receding at an alarming rate, transforming the mountain ecology. For us these may seem like quite unrelated developments. But for the Elder Brothers they are inextricably linked as the folly of the Younger Brothers and harbingers of the end of the world.

—Wade Davis

ELDER BROTHERS ON RECORD Helped by photographer Stephen Ferry, Indians of the Sierra Nevada are filming their own traditions and scenes from daily life. See the emerging record at nationalgeographic.com/magazine/0410.

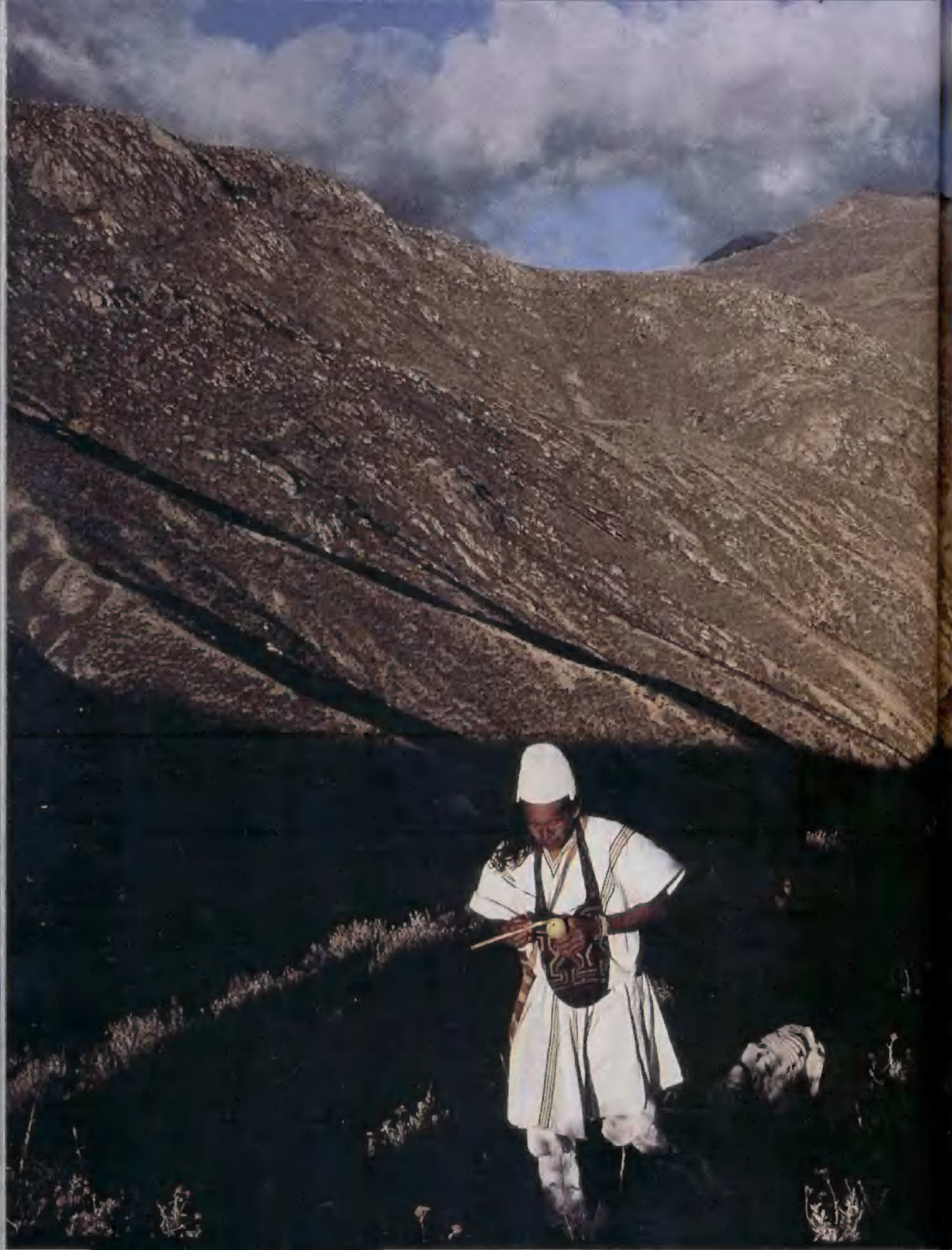


MEDITATION

After a surge of attacks against the Arhuaco and other Indians, priests summoned people from every Arhuaco village to an extraordinary spiritual session. As the leader Zarenkungemü, left center, explained, "We are asking the spiritual elders of nature to help us pacify the mountain." In the posture of ritual meditation, the Arhuaco held natural



materials—cotton fibers and bark—and for almost four hours directed thoughts, feelings, and prayers into them. When these objects were filled with spirit and concentrated thought, the priests collected them to present as offerings to the mountain in later secret rituals at sacred lagoons higher up on the mountain.



IMBALANCE

As Seiarimaku, an Arhuaco man, walked above the tree line at more than 14,000 feet, he lamented the loss of snow on the high peaks of the massif. "When I was a boy, the valley would be covered in snow even in summer, and there was ice on the surface of the river," Seiarimaku said. "Now it is too dry." Unfamiliar with the terms global warming



and greenhouse effect, indigenous leaders nonetheless see the recent aridity not only as a danger to the Sierra Nevada's more than 30 river basins but also as symptomatic of a world badly out of order. Says the Wiwa leader Mama Ramón Gil, "If this mountain is not cared for, the entire world will get sick."



THEY HAVE WATCHED IN HORROR AS OUTSIDERS HAVE VIOLATED THE HEART OF THE WORLD, TEARING DOWN THE FORESTS TO ESTABLISH PLANTATIONS.



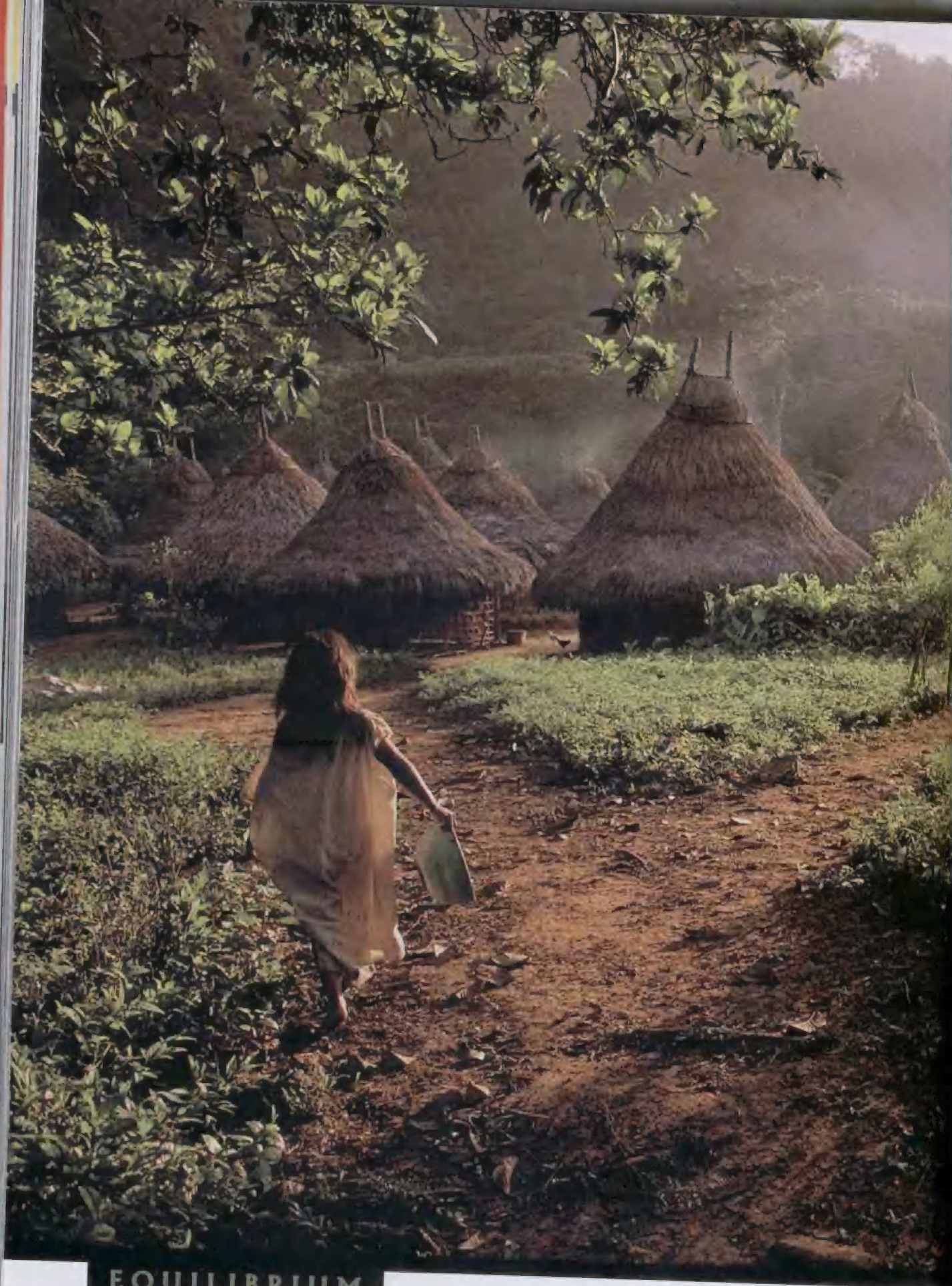
PRESSURE FROM ALL SIDES

Confident of their wisdom, the indigenous people on the mountain call themselves Elder Brothers and refer to the rest of us as Younger Brothers. Ever since the Spanish conquest destroyed the cities of the Tayrona civilization some four centuries ago, the descendants of this pre-Columbian culture have used the Sierra Nevada as a refuge against the aggressions of the Younger Brothers. Now, Indian leaders deplore

the clearing of their forests (below) by settlers, who, in addition to raising cattle and growing food crops, plant coca for the cocaine trade. Leftist guerrilla forces and their enemy—rightist paramilitary bands that often operate in tacit alliance with government troops—try to recruit Indian youth into their ranks. Army soldiers also regularly patrol on the mountain in search of information (top left).

Violence has unsettled the Sierra Nevada. I went with Indian leaders to the murder scene of Nicolás Izquierdo (bottom left), an Arhuaco farmer likely shot by paramilitaries. His killers had stripped him of his tunic and hat, changed him into non-Indian clothes, and displayed him on the road. This grotesque message seems to have been designed to frighten the Arhuaco into accepting paramilitary control of the area.





EQUILIBRIUM

Like all traditional villages on the mountain, the Kogi center of Chivilongui is a sacred site, cared for by a priest, or Mama, who can remember and pass down the social history and spiritual legacy of the village going back centuries. Villages are occupied only a few days a month, when people come together for spiritual work or communal labor.



The rest of the time they work small plots a day's walk or more away. The ceremonial men's house is the tallest structure. Twin poles emerging from the roofs represent the dual forces the Indians see throughout the universe and consider their responsibility to keep in balance: spirit and matter, outside and inside, male and female, creation and destruction.



RENEWAL

I didn't expect to see an accordion in the Arhuaco village of Mamánkana, more than 14,000 feet high, but there it was, played expertly as Seiarimaku and his wife's twin sister, Zarkundewa, danced with other villagers at a New Year's celebration. German families who settled in the Sierra Nevada had introduced the instrument, one of the



few items from the world of the Younger Brothers that the Arhuaco have chosen to assimilate into their conservative society. Even in the thin cold air at this altitude the villagers danced through the night and into the next day. For ceremonial occasions they set aside the accordion and instead play traditional drums and flutes.



THE LOOM, THE ACT OF SPINNING, THE NOTION OF A
COMMUNITY WOVEN INTO THE FABRIC OF A LANDSCAPE
ARE VITAL AND LIVING METAPHORS.



WOVEN WORLD


Deep in thought, a Kogi elder focuses on his *poporo* (below), the gourd carried from puberty by all indigenous men. Inside it they keep ground-up seashells, gathered from sacred beaches, which they lift out with a stick to mix with toasted coca leaves in their mouths. The chemical mix of coca leaves and powdered lime from the shells produces a mild, stimulating effect—unlike the intense high of cocaine—that

energizes them at this high altitude. They then use the stick to scrape the residue of saliva and calcium onto the surface of the gourd, which builds up gradually into a hard bulb, a symbol of a man's age and wisdom.

These Indians define all activities by gender. The mysteries of fertility and the correct balance between male and female are at the core of their beliefs. Thus the gourd is female, and the stick male,

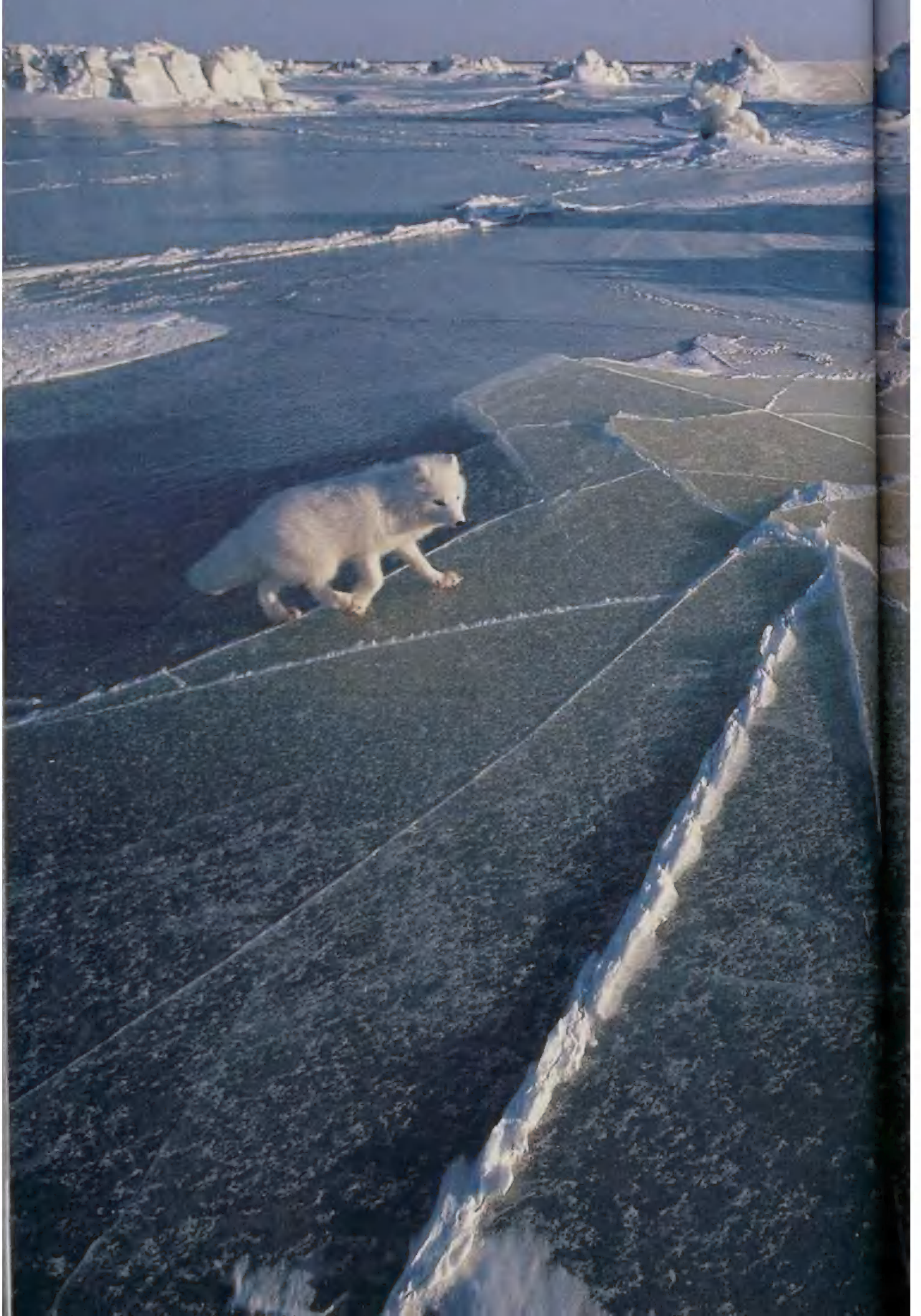
and their bringing together signifies conception. The creation of cloth also shows how gendered activities complement and balance each other. Just as the world was spun, women spin cotton and agave fiber into thread for clothes and belts (bottom left), while men weave the white threads into tunics and hats. Women maintain the whiteness of the clothing by washing tunics (left) in clean, cold mountain rivers.

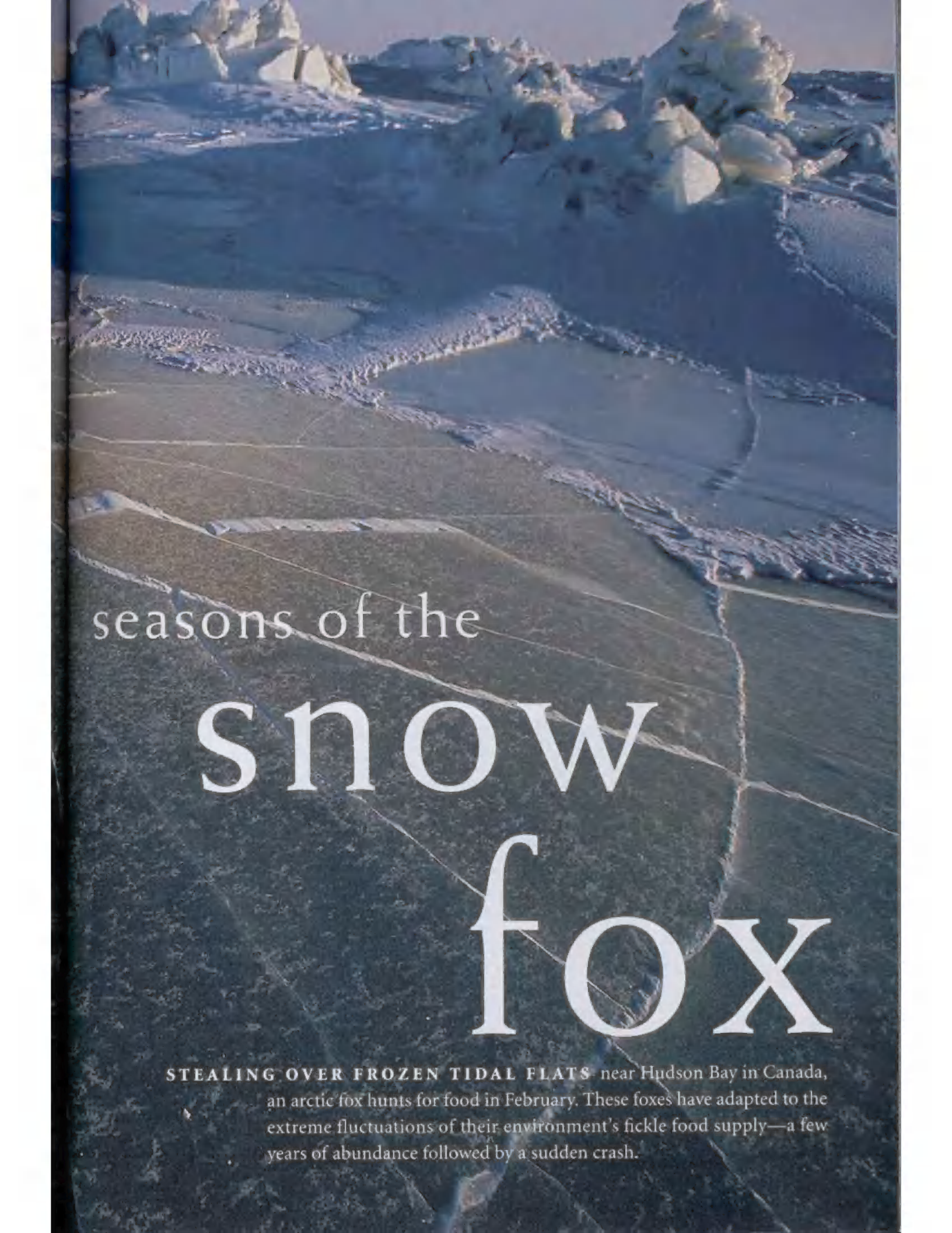


A dense, lush tropical forest with various types of ferns and broad-leafed plants. The scene is filled with greenery, including large fern fronds in the foreground and midground, and a thick canopy of smaller plants and vines in the background. The lighting is somewhat dim, suggesting a shaded forest environment.

A Kogi boy hastens up the almost 1,300 steps that lead to Teyuna, a major center in the Tayrona civilization, built around A.D. 1000. Since its discovery by the Younger Brothers in the 1970s, it has been known as Ciudad Perdida, or the Lost City. I joined these Kogi who were just returning to Teyuna after fear of guerrilla operations had made them flee the site some six months earlier. "We don't need possessions or treasures of any sort," an Arhuaco leader said. "If we can just take care of our sacred sites, we will lead a rich life." □







seasons of the

snow fox

STEALING OVER FROZEN TIDAL FLATS near Hudson Bay in Canada, an arctic fox hunts for food in February. These foxes have adapted to the extreme fluctuations of their environment's fickle food supply—a few years of abundance followed by a sudden crash.

BY JOHN L. ELIOT NATIONAL GEOGRAPHIC SENIOR WRITER
PHOTOGRAPHS BY NORBERT ROSING

winter ice

LET A RAVEN DROP a bone onto the ice or the aromas from a hunter's cook tent waft from a mile away, and a small white shadow will soon materialize to investigate—an arctic fox. Near Hudson Bay a fox's curious nose pokes around a knifelike ridge of ice (below). "It is the friendliest and most trusting of the North American foxes, although it is characterized . . . as 'impudent,'" wrote naturalist Barry Lopez.

In winter these small, almost delicate foxes range over huge areas seeking rodents or mammal carcasses. Some cross more than 600 miles of pack ice in 40-below-zero conditions. The species expanded in the Arctic at the end of the last warm interglacial period, about 120,000 years ago. Evolution equipped them with small ears, short muzzles, and thick fur to minimize heat loss. Their feet are fur-covered, like hares'—hence their scientific name, *Alopex lagopus*, or "hare-footed fox."







PLAY OR PREDATION? Hunting ringed seal pups born in small caves under the snow in Norway's Svalbard archipelago, a fox rears up (opposite top), jumps on a den (middle), and dives in headfirst (bottom). Pups often escape from the den into open water. The foxes' keen noses can detect such lairs more than a mile away. Near Hudson Bay, foxes tag along with polar bears in winter (below) to scavenge leftover seal carcasses.

Arctic foxes' most vital food source—or lack thereof—is a little fur ball called the lemming. Problem is, the rodents aren't reliable. "They don't commit mass suicide: That's a myth popularized by an old Walt Disney film," says James D. Roth, an ecologist at the University of Central Florida who has studied Hudson Bay foxes. "But lemmings do follow a natural boom-and-bust cycle. About every four years they're super-abundant, then they crash for one year, and gradually increase until the next peak." With a circumpolar range (map), arctic foxes probably total several hundred thousand, with wide fluctuations because of variations in the lemming populations.





A BLUE ARCTIC FOX chases a white arctic fox during early spring in Svalbard (opposite top). Most arctic foxes turn white in winter, but some have brownish blue fur (middle). Many blue foxes live in coastal areas, where they blend into dark backgrounds. Both color types live in Svalbard, where competition for mates rouses rivals in March. One sleeping male awakens and snarls when confronted by a challenger (opposite bottom). On a frigid morning another napping fox's steaming breath rises (below).

Some parts of the arctic foxes' range, like Svalbard, have no lemmings, so foxes there feed on seabirds, geese, and their eggs in summer. In winter the opportunist foxes scavenge seal and reindeer carcasses. Compared with Hudson Bay, Svalbard's fox population is more stable. "But because they rely on marine species, they have high concentrations of contaminants like PCBs," says Eva Fuglei, a wildlife biologist at the Norwegian Polar Institute, who is studying the effect of the toxics on the foxes' disease resistance and reproduction.





ALONE ON AN UNSTABLE WASTELAND, a fox prowls treacherous sea ice that in February can break up and refreeze in minutes. Along these tidal flats of the Churchill River near Hudson Bay, the fox may come across a seal carcass left by a polar bear. But the pickings are slim and hard to find amid such a constantly shifting ice field.





summer tundra

AS WILDFLOWERS REPLACE ice and snow, young foxes emerge from dens in July.

Lemming numbers have a huge impact on litter size. In 2002, when lemmings crashed in much of Canada, photographer Rosing found two sleepy pups (right) in a den of only seven on Victoria Island in the Canadian Arctic. The following year, when lemmings were plentiful, “this den near Churchill had 13 pups” (below), says Rosing, “and it was littered with lemming and bird carcasses.” One of the den’s adults forages to feed its young (above). These foxes have shed their white winter coats for the brown and cream fur of summer. Blue foxes also turn dark brown this time of year.

In good lemming years one female may have up to 20 pups, and local arctic fox populations boom. When lemming numbers plummet, many arctic foxes starve in winter, leading to fewer and smaller litters.

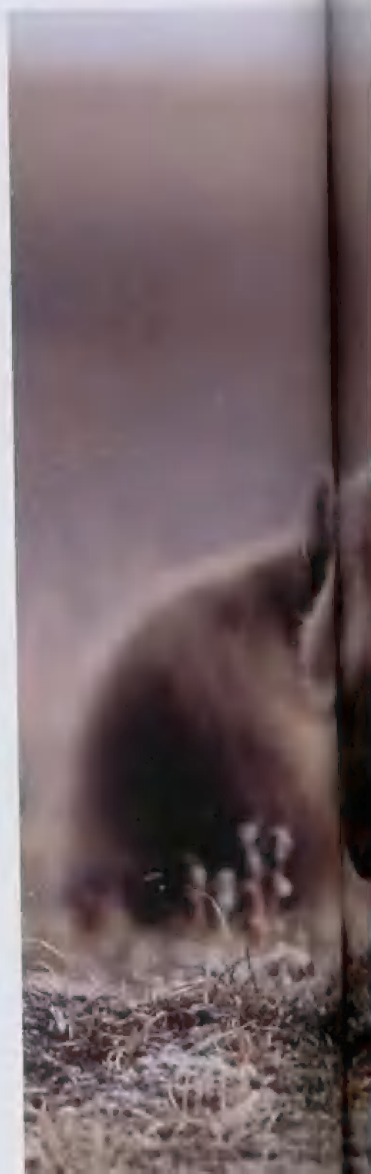






FOX IN THE GOOSE HOUSE: With more than a dozen hungry pups waiting, a female heads home with a mouthful of month-old snow goose. Critical to foxes during lean lemming years, about 100,000 snow geese nest on La Pérouse Bay near Churchill. "I found 72 geese feet in one Churchill den," says ecologist James Roth.





HOME ENTERTAINMENT at the den features endless play by arctic fox pups on Victoria Island (below and opposite center). Farther south, near Churchill, the father of the 13 pups leaps to join the fun (opposite bottom).

When the pups were about two weeks old, their mother moved them one by one (opposite top) to a new den. Heavy rain may have prompted her decision, or she may have sought a cleaner site. Dens are often used by many generations—for as long as 300 years. The burrow complex may spread over 500 square feet and have a hundred entrances, offering the pups quick escape from predators. Owls and eagles prey on young and adults, as do red foxes, a species from the south that overlaps the arctic foxes' range. Red foxes, which are considerably larger, also compete with arctic foxes for denning sites.

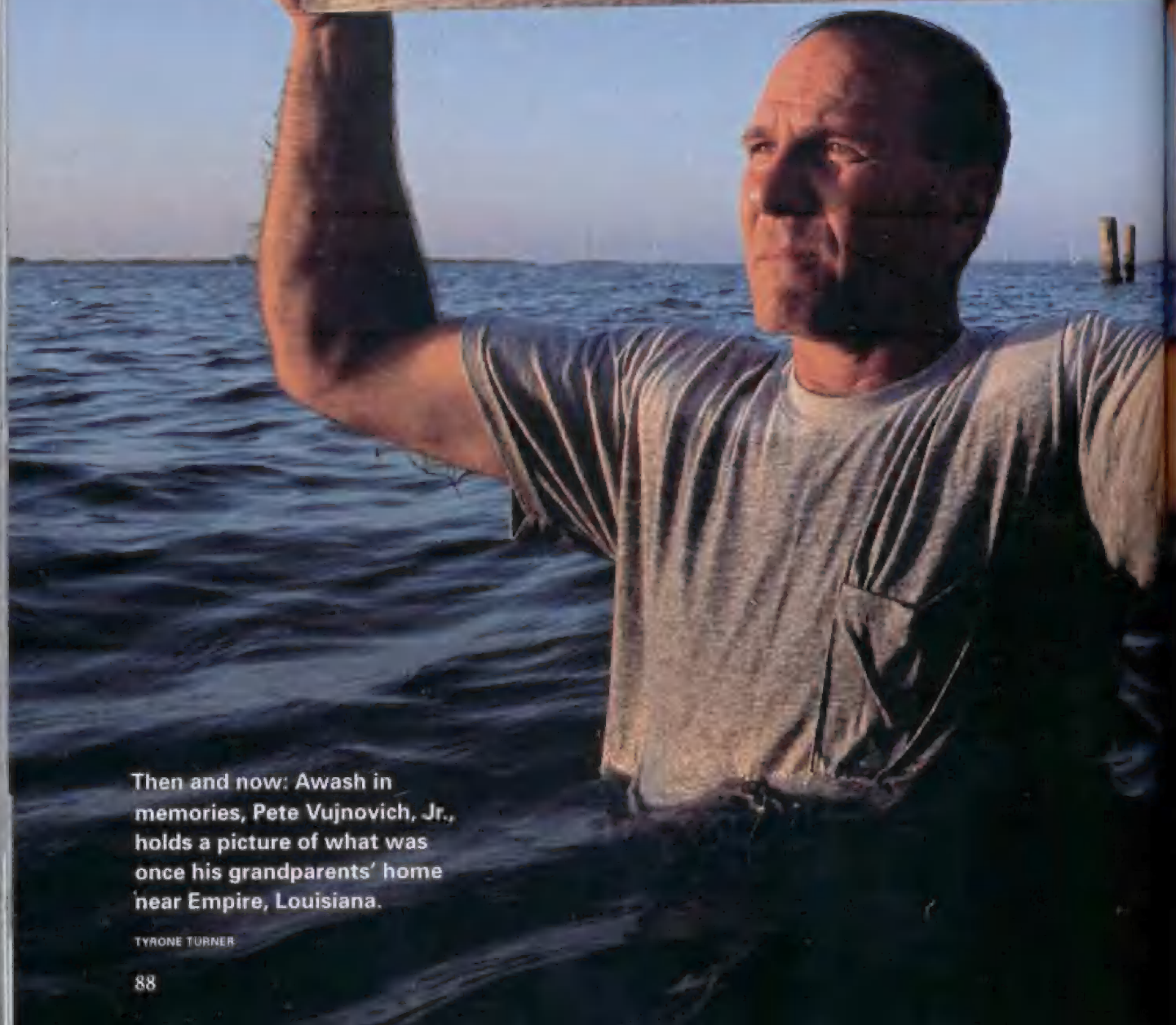
SPY THE FOX Experience the sights and sounds of arctic foxes, view more fox images, find foxy web links, and download fox wallpaper at nationalgeographic.com/magazine/0410.





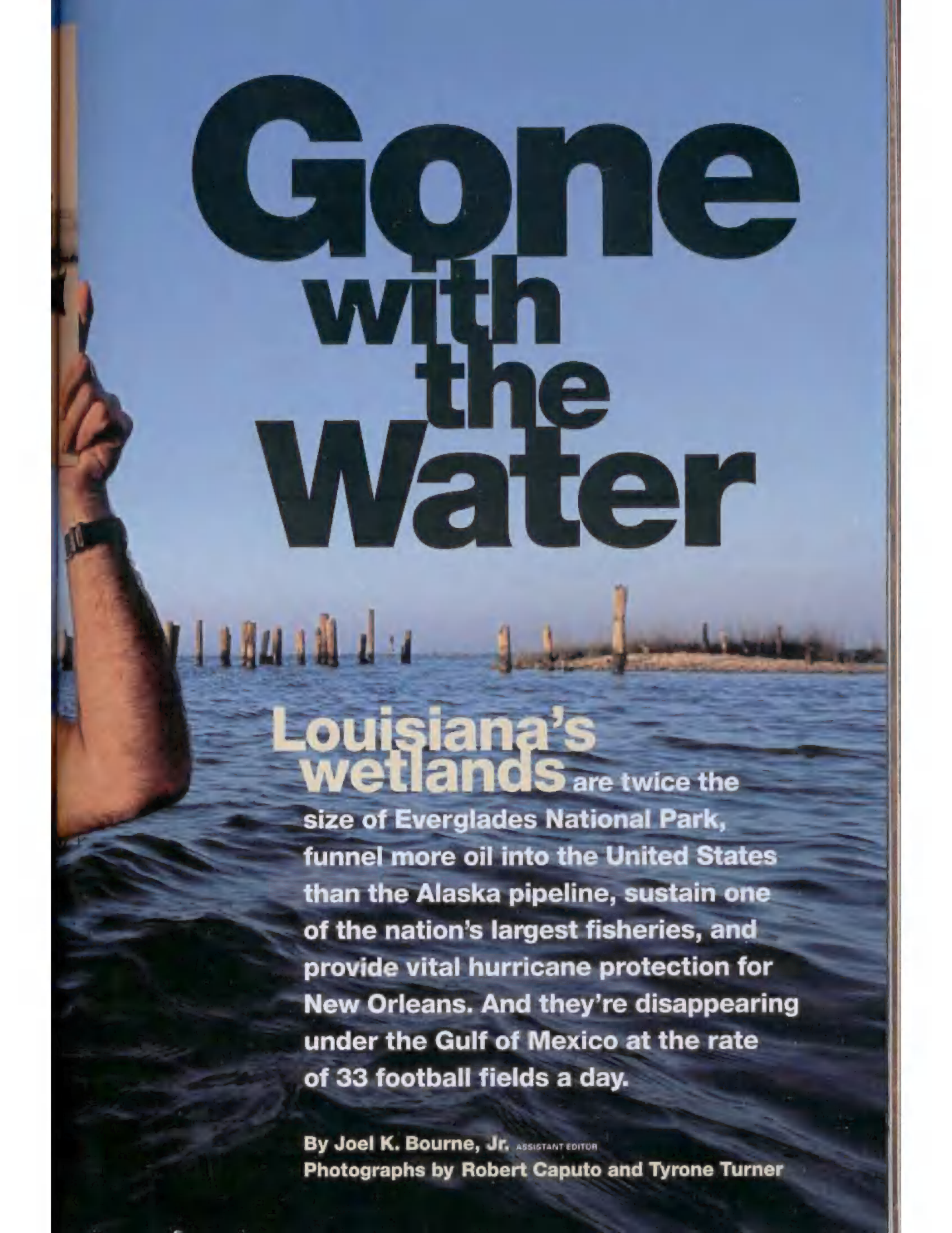
GLEAMING EYES peer through fireweed near Churchill. This two-month-old pup stays close to the den it shares with its 12 siblings. In years when food is abundant, adults feed their young through the summer until autumn, when the pups disperse. In lean years the pups leave the den earlier, to hunt on their own in a land where success is never a sure thing. □





Then and now: Awash in memories, Pete Vujnovich, Jr., holds a picture of what was once his grandparents' home near Empire, Louisiana.

TYRONE TURNER

A photograph of a person's arm holding a fishing rod, set against a background of a blue sky and a body of water with wooden pilings in the distance. The text is overlaid on the image.

Gone with the Water

Louisiana's wetlands are twice the size of Everglades National Park, funnel more oil into the United States than the Alaska pipeline, sustain one of the nation's largest fisheries, and provide vital hurricane protection for New Orleans. And they're disappearing under the Gulf of Mexico at the rate of 33 football fields a day.

By Joel K. Bourne, Jr. ASSISTANT EDITOR

Photographs by Robert Caputo and Tyrone Turner

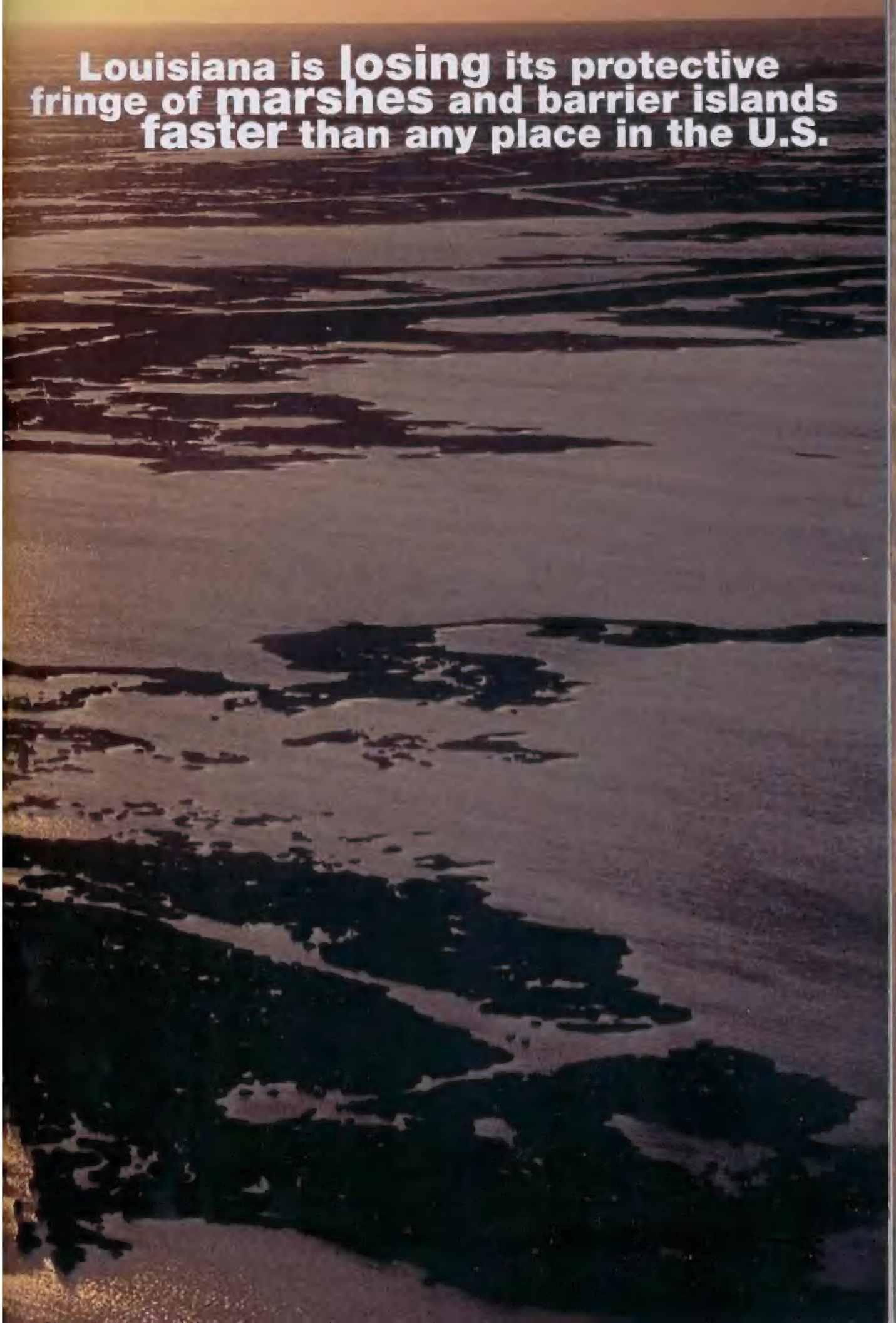
An aerial photograph of a marsh at sunset. A long, straight pipeline canal, appearing as a bright yellow line, cuts through the dark, textured wetlands. The sun is low on the horizon, creating a strong reflection on the water in the canal and casting long shadows. The overall color palette is dominated by warm yellows, oranges, and dark blues.

HUMAN TRACKS

in the form of pipeline canals slice through the marsh near Leeville, an area suffering a high rate of wetland loss. More than 8,000 miles of canals crisscross the state's wetlands, fueling erosion and saltwater intrusion and altering the natural hydrology.

C. C. LOCKWOOD

**Louisiana is losing its protective
fringe of marshes and barrier islands
faster than any place in the U.S.**



It was a broiling August afternoon in New Orleans, Louisiana, the Big Easy, the City That Care Forgot. Those who ventured outside moved as if they were swimming in tupelo honey. Those inside paid silent homage to the man who invented air-conditioning as they watched TV “storm teams” warn of a hurricane in the Gulf of Mexico. Nothing surprising there: Hurricanes in August are as much a part of life in this town as hangovers on Ash Wednesday.

But the next day the storm gathered steam and drew a bead on the city. As the whirling maelstrom approached the coast, more than a million people evacuated to higher ground. Some 200,000 remained, however—the car-less, the homeless, the aged and infirm, and those die-hard New Orleanians who look for any excuse to throw a party.

The storm hit Breton Sound with the fury of a nuclear warhead, pushing a deadly storm surge into Lake Pontchartrain. The water crept to the top of the massive berm that holds back the lake and then spilled over. Nearly 80 percent of New Orleans lies below sea level—more than eight feet below in places—so the water poured in. A liquid brown wall washed over the brick ranch homes of Gentilly, over the clapboard houses of the Ninth Ward, over the white-columned porches of the Garden District, until it raced through the bars and strip joints on Bourbon Street like the pale rider of the Apocalypse. As it reached 25 feet over parts of the city, people climbed onto roofs to escape it.

Thousands drowned in the murky brew that was soon contaminated by sewage and industrial waste. Thousands more who survived the flood later perished from dehydration and disease as they waited to be rescued. It took two months to pump the city dry, and by then the Big Easy was buried under a blanket of putrid sediment, a million people were homeless, and 50,000 were dead. It was the worst natural

disaster in the history of the United States.

When did this calamity happen? It hasn't—yet. But the doomsday scenario is not far-fetched. The Federal Emergency Management Agency lists a hurricane strike on New Orleans as one of the most dire threats to the nation, up there with a large earthquake in California or a terrorist attack on New York City. Even the Red Cross no longer opens hurricane shelters in the city, claiming the risk to its workers is too great.

“The killer for Louisiana is a Category Three storm at 72 hours before landfall that becomes a Category Four at 48 hours and a Category Five at 24 hours—coming from the worst direction,” says Joe Suhayda, a retired coastal engineer at Louisiana State University who has spent 30 years studying the coast. Suhayda is sitting in a lakefront restaurant on an actual August afternoon sipping lemonade and talking about the chinks in the city's hurricane armor. “I don't think people realize how precarious we are,” Suhayda says, watching sailboats glide by. “Our technology is great when it works. But when it fails, it's going to make things much worse.”

The chances of such a storm hitting New Orleans in any given year are slight, but the danger is growing. Climatologists predict that powerful storms may occur more frequently this century, while rising sea level from global warming is putting low-lying coasts at greater risk. “It's not if it will happen,” says University of New Orleans geologist Shea Penland. “It's when.”

Yet just as the risks of a killer storm are rising, the city's natural defenses are quietly melting away. From the Mississippi border to the

THE BIG ONE for the Big Easy, say hurricane experts, is a direct hit from a Category Five storm, which could dump 18 feet of water on Bourbon Street. That's a sobering thought for bar manager Casey Pommells, holding an 18-foot-long surveyor's rod. “People think it's going to happen sooner or later.”



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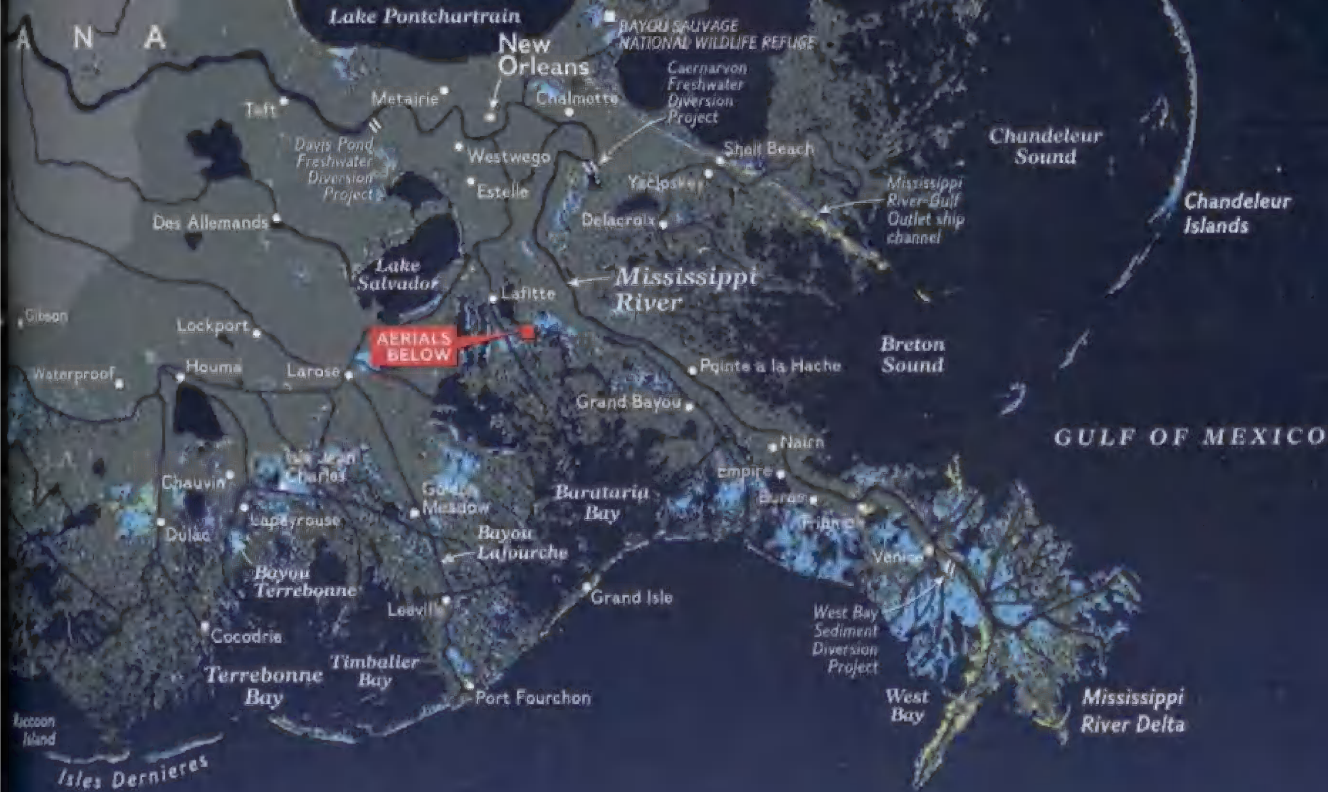
the Lost Coast

With the runoff from a third of the nation (inset map, far right), the Mississippi River built coastal Louisiana, a swath of marsh, islands, and swamp that covered more than 6,000 square miles in the early 20th century. Levees

raised in the 1930s ended spring floods that pumped vital sediments and nutrients into wetlands. Then nutria, a South American rodent imported by fur farmers, escaped into the wild and began devouring marsh

roots. By the 1960s the U.S. Army Corps of Engineers had dredged 14 major ship channels to inland ports, while oil companies cut countless canals for pipelines and wells (below). The resulting wetland loss is seen in





aerial photos of an oil field in the Barataria Basin (below). Add the toll from subsidence and sea-level rise, and Louisiana has lost 1,900 square miles of wetlands since the 1930s. With another 700 square miles likely to vanish

by 2050, the state has proposed an ambitious 14-billion-dollar plan to save what's left. "We ripped the guts out of south Louisiana," says University of New Orleans geologist Shea Penland. "Now we want it back."



1945



1998

Texas state line, Louisiana is losing its protective fringe of marshes and barrier islands faster than any place in the U.S. Since the 1930s some 1,900 square miles of coastal wetlands—a swath nearly the size of Delaware or almost twice that of Luxembourg—have vanished beneath the Gulf of Mexico. Despite nearly half a billion dollars spent over the past decade to stem the tide, the state continues to lose about 25 square miles of land each year, roughly one acre every 33 minutes.

A cocktail of natural and human factors is putting the coast under. Delta soils naturally compact and sink over time, eventually giving way to open water unless fresh layers of sediment offset the subsidence. The Mississippi's spring floods once maintained that balance, but the annual deluges were often disastrous. After a devastating flood in 1927, levees were raised along the river and lined with concrete, effectively funneling the marsh-building sediments to the deep waters of the Gulf. Since the 1950s engineers have also cut more than 8,000 miles of canals through the marsh for petroleum exploration and ship traffic. These new ditches sliced the wetlands into a giant jigsaw puzzle, increasing erosion and allowing lethal doses of salt water to infiltrate brackish and freshwater marshes.

While such loss hits every bayou-loving Louisianan right in the heart, it also hits nearly every U.S. citizen right in the wallet. Louisiana has the hardest working wetlands in America, a watery world of bayous, marshes, and barrier

efforts to save the Everglades. But the Bush Administration balked at the price tag, supporting instead a plan to spend up to two billion dollars over the next ten years to fund the most promising projects. Either way, Congress must authorize the money before work can begin.

To glimpse the urgency of the problem afflicting Louisiana, one need only drive 40 minutes southeast of New Orleans to the tiny bayou village of Shell Beach. Here, for the past 70 years or so, a big, deeply tanned man with hands the size of baseball gloves has been catching fish, shooting ducks, and selling gas and bait to anyone who can find his end-of-the-road marina. Today Frank "Blackie" Campo's ramshackle place hangs



Even the Red Cross no longer opens hurricane shelters in New Orleans, claiming the risk to its workers is too great.

islands that either produces or transports more than a third of the nation's oil and a quarter of its natural gas, and ranks second only to Alaska in commercial fish landings. As wildlife habitat, it makes Florida's Everglades look like a petting zoo by comparison.

Such high stakes compelled a host of unlikely bedfellows—scientists, environmental groups, business leaders, and the U.S. Army Corps of Engineers—to forge a radical plan to protect what's left. Drafted by the Corps a year ago, the Louisiana Coastal Area (LCA) project was initially estimated to cost up to 14 billion dollars over 30 years, almost twice as much as current

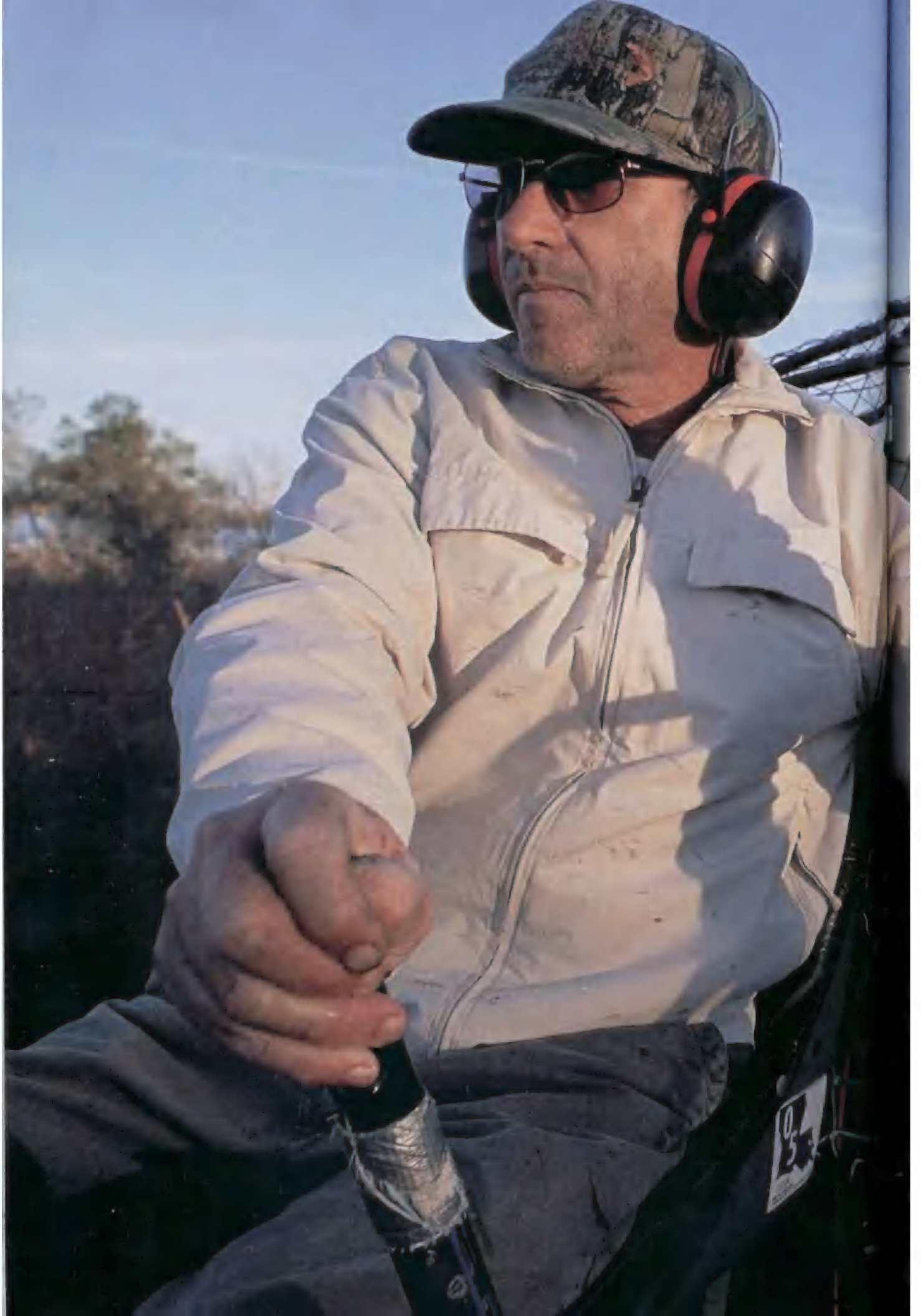
off the end of new Shell Beach. The old Shell Beach, where Campo was born in 1918, sits a quarter mile away, five feet beneath the rippling waves. Once home to some 50 families and a naval air station during World War II, the little village is now "ga'an pecan," as Campo says in the local patois. Gone forever.

Life in old Shell Beach had always been a tenuous existence. Hurricanes twice razed the community, sending houses floating through the marsh. But it wasn't until the Corps of Engineers dredged a 500-foot-wide ship channel nearby in 1968 that its fate was sealed. The Mississippi River-Gulf Outlet, (Continued on page 101)




"WHEN I WAS A KID, you could walk through the swamp in summer in dress shoes," says 80-year-old Elward Stephens (above), wading through cypress knees near Morgan City. Today the swamp never dries out. Other changes are more dramatic: Thousands of acres of bald cypress (below) have been killed by saltwater flowing up canals, while once buried pipelines now lie exposed and must be regularly marked (left) to keep them from being struck by boats.





As wildlife habitat, south Louisiana makes the Everglades look like a petting zoo.



"MY FIRST PET was an alligator," says airboat guide Gordon Matherne, who shows tourists the wonders—and problems—of Louisiana's coast. The state's wetlands host staggering numbers of wildlife, from more than a million alligators to tiny neotropical songbirds. Up to 24 million birds a day land on the coast during peak migrations.

TYRONE TURNER



"IF YOU'RE LOW DOWN, you lose a lot," says Kissy Dardar (above, mowing grass), who raised her trailer on Isle Jean Charles to avoid frequent floods. A crawfish boil draws family and friends to the table of commercial fisherman T-Roy Borne (below), who blames marsh loss for poor catches. Hard times pack the pews, says assistant pastor Paul Sylve, Sr. (right), who collects parishioners in Grand Bayou by boat. "They desperately pray something will change."



known as "Mr. Go," was supposed to provide a shortcut for freighters bound for New Orleans, but it never caught on. Maybe two ships use the channel on a given day, but wakes from even those few vessels have carved the shoreline a half mile wide in places, consuming old Shell Beach.

Campo settles into a worn recliner, his pale blue eyes the color of a late autumn sky. Our conversation turns from Mr. Go to the bigger issue affecting the entire coast. "What really screwed up the marsh is when they put the levees on the river," Campo says, over the noise of a groaning air-conditioner. "They should take the levees out and let the water run; that's what built the land. But we know they not going to let the river run again, so there's no solution."

Denise Reed, however, proposes doing just



that—letting the river run. A coastal geomorphologist at the University of New Orleans, Reed is convinced that breaching the levees with a series of gated spillways would pump new life into the dying marshes. Only three such diversions currently operate in the state. I catch up with Reed at the most controversial of the lot—a 26-million-dollar culvert just south of New Orleans named Caernarvon.

"Caernarvon is a prototype, a demonstration of a technique," says Reed as we motor down a muddy canal in a state boat. The diversion isn't filling the marsh with sediments on a grand scale, she says. But the effect of the added river water—loaded as it is with fertilizer from farm runoff—is plain to see. "It turns wetlands hanging on by the fingernails into something quite lush," says Reed.

To prove her point, she points to banks crowded with slender willows, rafts of lily pads,

and a wide shallow pond that is no longer land, no longer liquid. More like chocolate pudding. But impressive as the recovering marsh is, its scale seems dwarfed by the size of the problem. "Restoration is not trying to make the coast look like a map of 1956," explains Reed. "That's not even possible. The goal is to restore healthy natural processes, then live with what you get."

Even that will be hard to do. Caernarvon, for instance, became a political land mine when releases of fresh water timed to mimic spring floods wiped out the beds of nearby oyster farmers. The oystermen sued, and last year a sympathetic judge awarded them a staggering 1.3 billion dollars. The case threw a major speed bump into restoration efforts.

Other restoration methods—such as rebuilding marshes with dredge spoil and salt-tolerant plants or trying to stabilize a shoreline that's eroding 30 feet a year—have had limited success. Despite the challenges, the thought of doing nothing is hard for most southern Louisianans to swallow. Computer models that project land loss for the next 50 years show the coast and interior marsh dissolving as if splattered with acid, leaving only skeletal remnants. Outlying towns such as Shell Beach, Venice, Grand Isle, and Cocodrie vanish under a sea of blue pixels.

Those who believe diversions are the key to saving Louisiana's coast often point to the granddaddy of them all: the Atchafalaya River. The major tributary of the Mississippi River, the Atchafalaya, if left alone, would soon *be* the Mississippi River, capturing most of its flow. But to prevent salt water from creeping farther up the Mississippi and spoiling the water supply of nearby towns and industries, the Corps of Engineers allows only a third of the Mississippi's water to flow down the Atchafalaya. Still, that water and sediment have produced the healthiest wetlands in Louisiana. The Atchafalaya Delta is one of the few places in the state that's actually gaining ground instead of losing it. And if you want to see the delta, you need to go crabbing with Peanut Michel.

"Peanut," it turns out, is a bit of a misnomer. At six foot six and 340 pounds, the 35-year-old commercial fisherman from Morgan City wouldn't look out of place on the offensive line of the New Orleans Saints. We launch his aluminum skiff in the predawn light, and soon we're skimming down the broad, café au lait

river toward the newest land in Louisiana. Dense thickets of needlegrass, flag grass, cut grass, and a big-leaved plant Michel calls elephant ear crowd the banks, followed closely by bushy wax myrtles and shaggy willows.

Michel finds his string of crab pots a few miles out in the broad expanse of Atchafalaya Bay. Even this far from shore the water is barely five feet deep. As the sun ignites into a blowtorch on the horizon, Michel begins a well-oiled ritual: grab the bullet-shaped float, shake the wire cube of its clicking, mottled green inhabitants, bait it with a fish carcass, and toss. It's done in fluid motions as the boat circles lazily in the water.

But it's a bad day for crabbing. The wind and water are hot, and only a few crabs dribble in. And yet Michel is happy. Deliriously happy. Because this is what he wants to do. "They call 'em watermen up in Maryland," he says with a slight Cajun accent. "They call us lunatics here. You got to be crazy to be in this business."

Despite Michel's poor haul, Louisiana's wetlands are still a prolific seafood factory, sustaining a commercial fishery that most years lands more than 300 million dollars' worth of finfish, shrimp, oysters, crabs, and other delicacies. How long the stressed marshes can maintain that production is anybody's guess. In the meantime, Michel keeps at it. "My grandfather always told me, Don't live to be rich, live to be happy," he says. And so he does.

After a few hours Michel calls it a day, and we

to a dock, but to a gas pump: These wetlands protect one of the most extensive petroleum infrastructures in the nation.

The state's first oil well was punched in south Louisiana in 1901, and the world's first offshore rig went into operation in the Gulf of Mexico in 1947. During the boom years in the early 1970s, fully half of the state's budget was derived from petroleum revenues. Though much of the production has moved into deeper waters, oil and gas wells remain a fixture of the coast, as ubiquitous as shrimp boats and brown pelicans.

The deep offshore wells now account for nearly a third of all domestic oil production, while Louisiana's Offshore Oil Port, a series of platforms anchored 18 miles offshore, unloads a nonstop line of supertankers that deliver up to 15 percent of the nation's foreign oil. Most of that black gold comes ashore via a maze of pipelines buried in the Louisiana muck. Numerous refineries, the nation's largest natural gas pipeline hub, even the Strategic Petroleum Reserve are all protected from hurricanes and storm surge by Louisiana's vanishing marsh.

You can smell the petrodollars burning at Port Fourchon, the offshore oil industry's sprawling home port on the central Louisiana coast. Brawny helicopters shuttle 6,000 workers to the rigs from here each week, while hundreds of supply boats deliver everything from toilet paper to drinking water to drilling lube. A thousand trucks a day keep the port humming around the

With 30 percent of the coastal marshes in the lower 48 states, Louisiana suffers 90 percent of the marsh loss.

head through the braided delta, where navigation markers that once stood at the edge of the boat channel now peek out of the brush 20 feet from shore. At every turn we flush mottled ducks, ibis, and great blue herons. Michel, who works as a hunting guide during duck season, cracks an enormous grin at the sight. "When the ducks come down in the winter," he says, "they'll cover the sun."

To folks like Peanut Michel, the birds, the fish, and the rich coastal culture are reason enough to save Louisiana's shore, whatever the cost. But there is another reason, one readily grasped by every American whose way of life is tethered not

clock, yet Louisiana 1, the two-lane highway that connects it to the world, seems to flood every other high tide. During storms the port becomes an island, which is why port officials like Davie Breaux are clamoring for the state to build a 17-mile-long elevated highway to the port. It's also why Breaux thinks spending 14 billion dollars to save the coast would be a bargain.

"We'll go to war and spend billions of dollars to protect oil and gas interests overseas," Breaux says as he drives his truck past platform anchors the size of two-story houses. "But here at home?" He shrugs. "Where else you gonna drill? Not California. Not Florida. Not in ANWR.



THE BATTLE AGAINST land loss has many fronts. The National Guard each year drops discarded Christmas trees from New Orleans into nearby Bayou Sauvage National Wildlife Refuge in an attempt to halt erosion. More substantial breakwaters built on Racoon Island (below left) slowed but failed to stop shoreline loss of 60 feet a year. That's bad news for tri-colored herons (right), whose nesting population has plummeted in the state since the 1970s.



NATIONAL
GEOGRAPHIC
RESEARCH AND
EXPLORATION



GÖRAN NILSON

GRANTEES

**Claes Andrén and
Göran Nilson,
Zoologists, Göteborg
University, Sweden**

"When we discover a new
species of reptile, the reward
is absolutely overwhelming."

—Claes Andrén

All wound up, a four-foot-long
cat snake (*Telescopus tessellatus
martini*, right) has a poisonous bite,
but doesn't lay a fang on Andrén
(above): "We didn't know this tough
guy existed in Iran."

Determined to survey Iran's reptiles, two scientists go

Into Wild the Wild



By Alan Mairson

NATIONAL GEOGRAPHIC SENIOR WRITER

Photographs by Claes Andrén

How many years did two Swedish zoologists have to wait before they could tell this story? "Almost 30," says Claes Andrén of his unintentionally long-term research project with colleague Göran Nilson. "We did our initial fieldwork in Iran in the mid-1970s, when the shah was head of state. But the Islamic revolution and the Iran-Iraq war made it impossible for Western scientists to work there."

Then in 2000, a door opened. Nasrullah Rastegar-Pouyani, an Iranian student at Göteborg University who was doing his dissertation on Iran's reptiles, helped Andrén and Nilson get back inside the country.

Their mission in Iran was to

survey its herpetofauna: How many different species of reptiles and amphibians could they find? What were their habitats? Of special interest was the fate of a viper (*Vipera latifii*) that many zoologists feared had gone extinct in the late 1970s, when a new dam flooded critical habitat in the Elburz Mountains. "We're happy to have discovered that a few hundred vipers were still alive," Andrén reports.

During two expeditions the survey team collected 82 species of herpetofauna out of the 230 that were known to exist in Iran—plus ten new species. One of the "most fascinating" was a gray-beige lizard with a long blue tail found on a steep mountain slope. "We also have

THE PROJECT

PLACE: Iran's central plateau and mountain ranges

GOAL: To study the diversity and distribution of Iran's reptiles and amphibians, and how mountains affect their dispersal

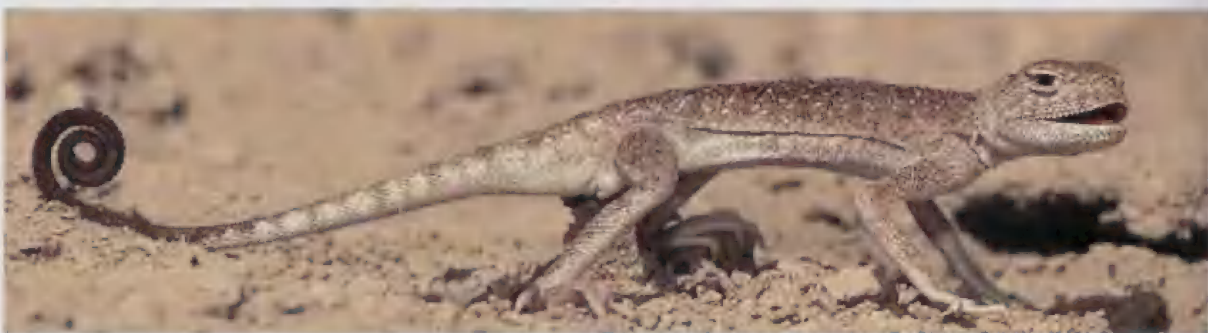
BIGGEST RISKS: Land mines, snakebites, hazardous roads

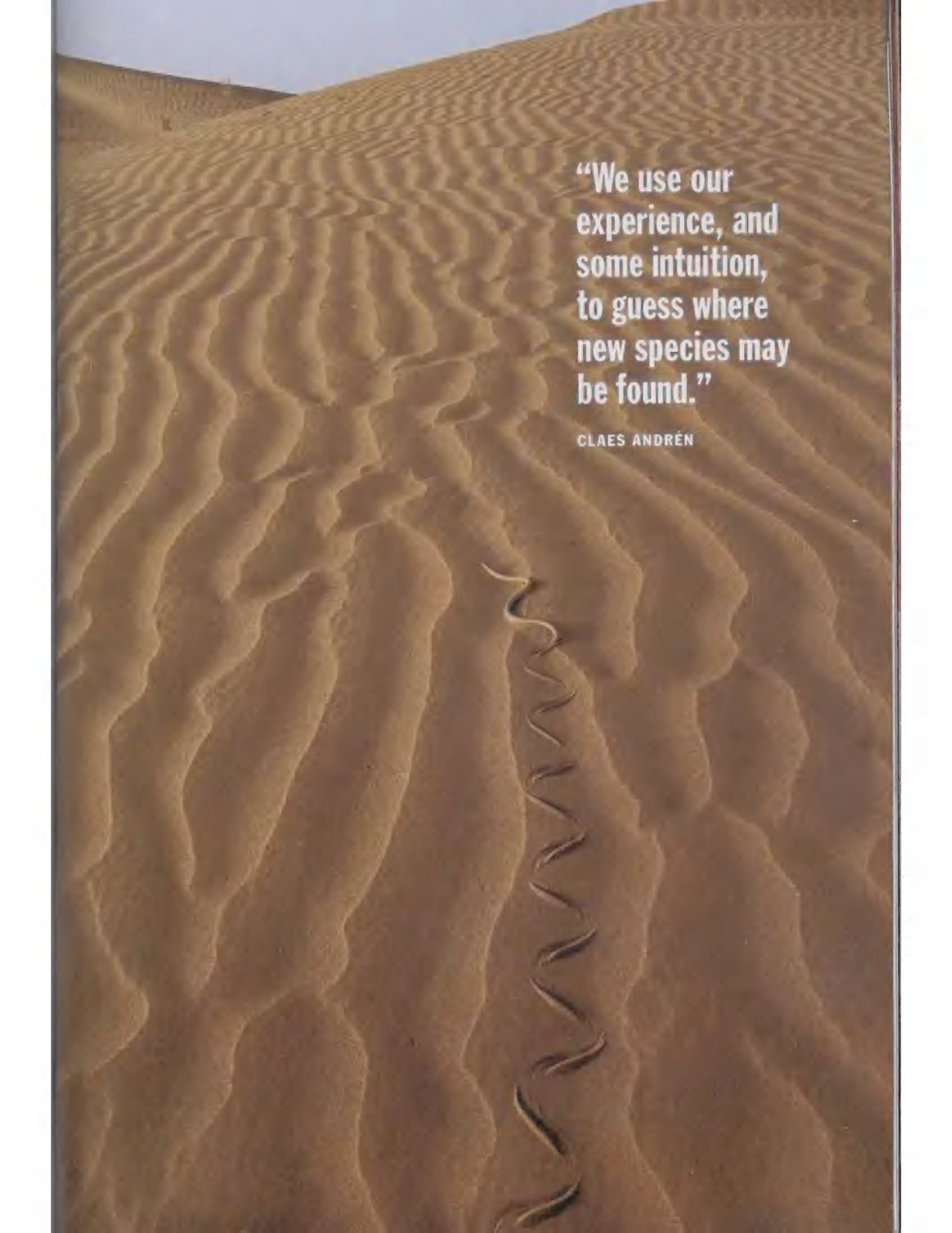
UNQUENCHED DESIRE: After a hot day, a cold beer (illegal in Iran)

some dwarf geckos and snakes that are waiting in Sweden for their scientific names," says Andrén, who knows a few things about waiting. □

WRIGGLING REPTILES To learn more about the world's reptiles, see websites and a bibliography at nationalgeographic.com/magazine/0410.

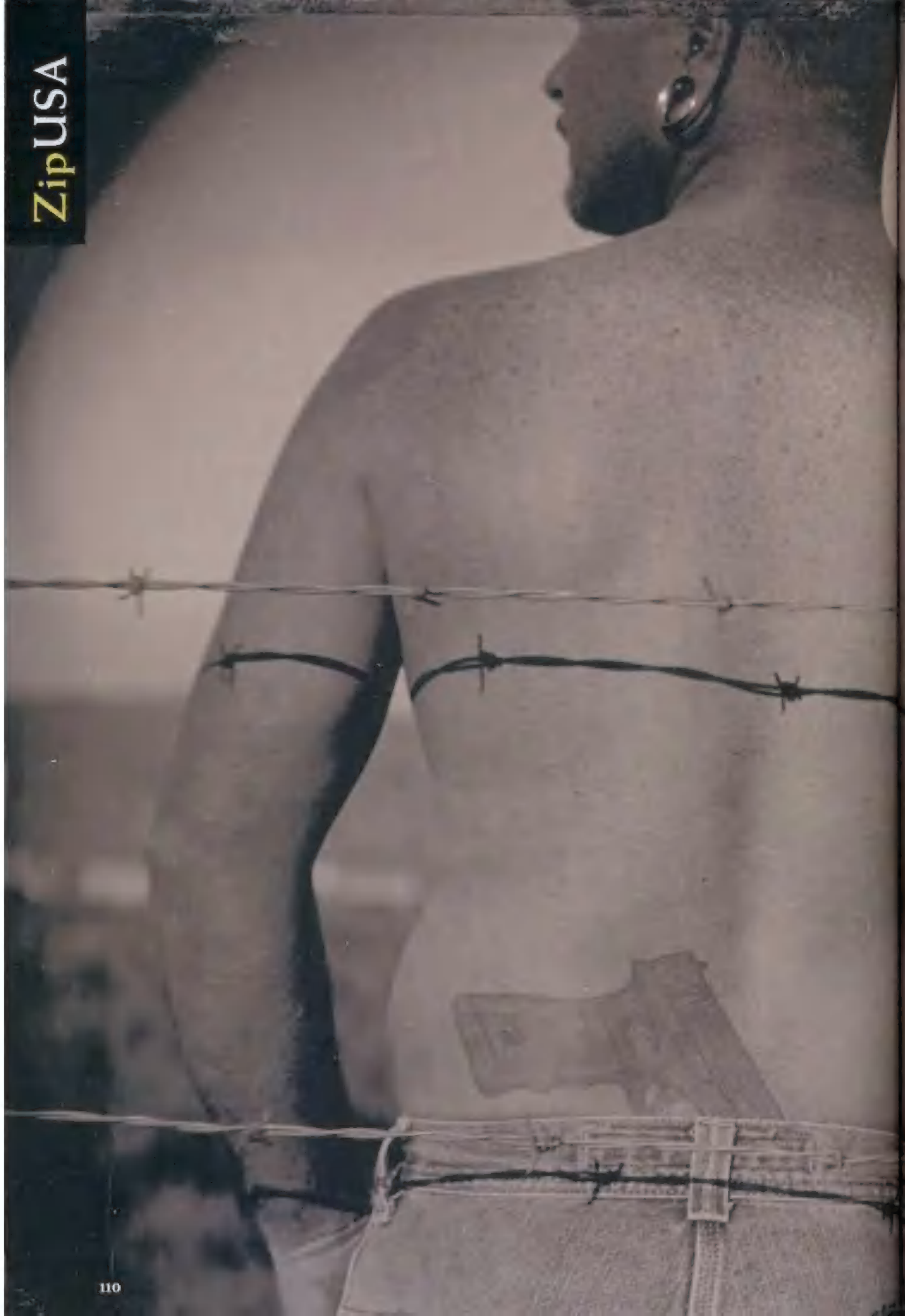
In the wilderness of Iran it pays to watch your step. An awl-headed snake navigates a sea of sand (opposite), and a black-tailed toad agama keeps cool by lifting its body off the broiling soil (below) when temperatures top 100°F. Wielding a snake hook, Göran Nilson, a curator at Göteborg's Natural History Museum, snags a poisonous blunt-nosed viper (bottom left). Found in a mountain valley, a new subspecies of Brandt's lizard (bottom right) reveals itself to science.





**“We use our
experience, and
some intuition,
to guess where
new species may
be found.”**

CLAES ANDRÉN



ELKO, NEVADA

BY KATE KRAUTKRAMER

PHOTOGRAPHS BY ROBB KENDRICK

89801

**Check out the gun tattoo . . . and 49
other things to do in Elko, Nevada.**

A tattooed pistol and a stretched earlobe distinguish Brent Taylor, a body-piercing and branding artist who moonlights as a gold miner. Individuality thrives in the wide-open spaces around Elko—a cattle town at the heart of one of the world's richest gold-producing regions. It's a place where plenty of people, including Taylor, pack real guns. That's one reason, he says, why mutual respect prevails among people who seem to have little in common.



ELKO, NEVADA

TINTYPES

These photographs are tintypes, a process developed in the 19th century as an alternative to the costlier daguerreotype. The popular technique, often used to photograph cowboys and Civil War soldiers, produces an image on a blackened sheet of iron coated with light-sensitive material. Though faster than a daguerreotype, it requires poses of several seconds. The resulting positive images appear backward, as in a mirror.



SAME TOWN, DIFFERENT WORLDS

Ashley Riggs (above) is growing up on the 200,000-acre Maggie Creek Ranch, where her father is cow boss. The home-schooled 16-year-old likes to ride and pitches in at branding time, but her passion is period costume design.

Prostitutes (left) from one of Elko's five legal brothels stand in front of the Commercial Hotel Casino. Tourists from around the country take cheap casino planes to the city to sample Elko's diversions.

ELKO, NEVADA

Take in the scene. Register the commanding Western mystique. Note iconoclastic characters: gold miner, prostitute, cowboy. Be dazzled by the casino lights. Close your eyes and try to locate a rhythm in the ping-ping-ping of the slot machines. Play slots in the grocery store, the gas stations, the hotels.

Explore the Pioneer Hotel—home of the Western Folklife Center and Elko's most famous event, the annual Cowboy Poetry Gathering, which this year drew a crowd of 8,000 people. Wonder if there are 8,000 extra beds. Witness Elko's native son, cowboy poet Waddie Mitchell, demonstrate his penchant for metaphor when he says, "That buckaroo was squealing like a piglet on caffeine, madder than a constipated badger on the fight." Listen to him talk about leaving a life of working cattle and riding out on the Nevada range. Notice his voice goes low, like he's eulogizing an old friend. Invite Waddie Mitchell to lunch at the Star Hotel dining hall, where he's greeted by a waitress who knows his name and what he'll likely order, which is a plate made heavy with beef lost in the wrinkles of gravy, otherwise known as the boarders' lunch, the boarders being a few elderly Basque gentlemen who occupy the upstairs bedrooms and come down for meals when a bell is rung. Try to pronounce the boarders' vowel-laden names. Learn how Basques have stayed on here in Elko—once a railroad town, once a cattle town, once a Nevada town that, before



BUCKAROO'S BOY

Two-year-old Eduardo Solis first sat on a horse at two months of age. His father, lifelong cowboy Salvador Solis, who rides for the Bear Ranch, had to hold him up in the saddle. Today the toddler needs no such help.

"He's crazy for animals," says his dad. "He likes it here on the ranch. He don't like it in town."

ELKO, NEVADA



WESTERN GALLERY

The old and the new West mix in Elko. Craig Youngblood's piercing stare (clockwise from upper left) harks back to cowboy pictures of an earlier era. Cody Schroeder, 18, defensive lineman for the Elko Indians, may be the smallest starting high school nose tackle in Nevada at 5 feet 7 inches tall. Jay Wicks, 63, a retired upholsterer, once told his wife he wished he could live as a prospector, roaming the mountains on a mule. John Wright demonstrates a bedroll and a range tepee—old-fashioned but still practical gear sold at J. M. Capriola's, his parents' cowboy outfitting store.

ELKO, NEVADA

Reno and Las Vegas caught on, was the locus of big-name entertainment and the part-time home of honorary mayor Bing Crosby, who occasionally showed up at a Catholic Mass, much to the delight of the congregation, which silenced itself in favor of his singing. Try to recall Crosby's voice, possibly just as silky and clear as the Nevada sky this afternoon as it segued into horizon just beyond I-80 to the north, past the Elko High School football field where the team was practicing, anticipating another game against the Green Wave, their closest rivals, 250 miles away in Fallon. Try to stare down the school mascot, a Native American in a war bonnet, painted on the neat red bricks of the outside gym wall. Remark on the students of many races wearing their Indian jerseys with no apparent cultural qualms. Find out that the Te-Moak Tribe of Western Shoshone has not only given its sanction for the school to keep Indians as the mascot, it's also endorsed the school's marching band, "Pride of Nevada, the Band of Indians," as an organization that casts the Te-Moak people in a positive light. Observe the blank looks when you ask a group of high school kids if they ever venture onto the three Native American colonies, the urban equivalent of reservations, inside Elko city limits. Realize that they think of the colonies as a good place to purchase fireworks. Try to memorize their smooth, young faces. Lament your lost youth. Recall your unrequited desire to become a cowgirl. Believe it when

89801

Elko

POPULATION: *Carson City

16,280

ESTABLISHED: 1868

ELEVATION: 5,140 feet

COST OF A SADDLE IN

1970: \$300

COST TODAY: \$2,500

NUMBER OF BASQUE

RESTAURANTS: 4

NUMBER OF BUILDINGS

HEATED WITH GEOTHER-

MAL ENERGY: 37



BUCKLE DOWN

Dan "Pook" Hoots's saucer-size belt buckle commemorates his bronc-riding victory in the 2001 Payette County Rodeo, an amateur event in Idaho. "I'd like to be a professional rider someday," the 21-year-old Elko resident says.

Until then, he'll keep working as a cowboy, crisscrossing the West on weekends in pursuit of his goal.

ELKO, NEVADA

several teenagers declare their intent to stay here after they graduate—praising their town with phrases like “a good place to have kids and raise a family,” “a safe place,” and “I could see staying here forever.”

Let your imagination range out on the surrounding Great Basin, a huge spread covering most of Nevada, a good chunk of Utah, and slivers of Oregon, California, Idaho, and Wyoming—a piece of America irreverent toward the rule of the Continental Divide, where streams do not flow to the sea, and the only escape is through evaporation or to sink into the ground. Work to include the analogy in your narrative.

Speak to a man with a gun tattooed into the back of his pants, who says, “I’ve lived here 15 years. No one ever leaves, and if they do they come right back.” When he tells you he’s married to a “classically trained” ballet dancer, do not act surprised. When he explains that in this part of the world, people tend to confuse “dancer” with “stripper,” laugh—but only a little.

With 2,000 other people, sit in the fairground bleachers for the annual demolition derby. Watch the drivers slam into one another’s cars. Breathe in the blue exhaust and smoke. Cheer wildly for the winner. Pretend you live here. Absorb the contrasts. Notice contradiction exhibited by the town’s layout: to the north, acres of mowed lawn surrounding a convention center, a public swimming pool, and the newly remodeled campus of Great Basin College; to the south, casinos, hotels, restaurants, and a little row of legal brothels held in to the community by a set of railroad tracks headed east and west toward miles of sagebrush and wide-open high desert.

Land in a coffee shop called Cowboy Joe just off the main drag. While sipping iced cappuccino, reflect on the American West, cowboys, manifest destiny, and romanticized love for rugged, unyielding land. Ask a folklorist who has dropped in from down the block if she likes cowboys. Detect the flame in her eyes when she smiles and says, “Well, you’ve seen ‘em, right?”

Down the way at J. M. Capriola’s Western Wear store, enjoy watching a worker stroke the folds of leather on his bench, bending down as if he had a secret with the saddle.

Walk down Idaho Street, right through the center of town. Listen to some kids blow rap music from their souped-up cars. Watch a real buckaroo in worn Wranglers, chaps, and spurs walk past a yoga studio while talking on a cell phone. Catch a whiff of him. Inhale traces of sagebrush and rawhide escaped to town and free-floating on the air. Notice the cowboy riding off into the sunset in a truck built about the year you were born. Smile and keep walking. Hum a Western tune you know by heart. □

TINTYPE TUTORIAL Find out how to make tintypes from photographer Robb Kendrick in a multimedia feature and view more 89801 images along with field notes and resources at nationalgeographic.com/magazine/0410.

MYTH AND REALITY
A rodeo cowboy left this well-worn riding boot (holding both his spurs) on a fence post. In Elko the American West that exists in folklore—a place of individual freedom, self-reliance, and backbreaking work—is more than legend.



Final Edit



ARCTIC FOX

Moonscape

Photographer Norbert Rosing had seen an arctic fox repeatedly prowling an area of icy ridges around the western shore of Hudson Bay near the town of Churchill in Canada. He caught this memorable image as the full moon set early one February morning. "Rosing waited for a magic moment when the animal was in the perfect situation," says photo editor John Echave.

So why wasn't the picture included in our article? In winter the foxes live in a land of ice, yielding dramatic photos—white foxes on white ice—but it's possible to have too many of a good thing. "In a story like this, there's only so much ice you can look at," says design editor David Whitmore. This image, striking as it is, was judged too similar to the one on pages 78-9 that features the sun near the horizon. Rosing also varied the coverage by photographing the foxes around their dens in their summer tundra habitat, "giving the story a very important extra dimension," says Whitmore.

WEBSITE EXCLUSIVE

Cut it or keep it? Find out more about what tipped the balance for this photograph and e-greet a friend with it at nationalgeographic.com/magazine/0410.

ON ASSI

ON THE ROAD, IN THE FIELD.



GOVERNMENT

C O V E R I N G T H E W O R L D



HAWAII VOLCANOES

Feeling the Heat

How to photograph volcanoes without getting burned

Shooting through the swirl of toxic fumes on erupting Kilauea on Hawai'i meant that **Frans Lanting** (above) had to wear a bulky breathing apparatus—"even sleeping," he

recalls. If the risk of inhaling the gases wasn't enough to disturb the photographer's rest, the heat radiating from the ground just beneath his sleeping bag was another reminder that "a volcano

is a living thing, a dangerous thing," he says. Even his own voice seemed menacing on the erupting mountain. "Those masks," notes Frans, "make you sound just like Darth Vader."



ELEONORE ROSING (ABOVE); TYRONE TURNER

ARCTIC FOX

Outfoxing Polar Bears

In the far north, says **Norbert Rosing** (above, in Churchill, Manitoba), “everything goes in cycles. Last year food was plentiful for arctic foxes—lots of lemmings, lots of geese. I watched

one den for five days and got all the shots I needed.”

The photographer almost became part of that food supply himself. One day a polar bear lured by cooking smells began

pushing and biting at the fence surrounding Norbert’s camp. Norbert yelled and fired warning shots to scare it, to no avail. Finally, six feet from the bear and separated only by the weakening fence, he aimed a jet of pepper spray at its eyes, and it fled. “I hear he was back the next day,” says Norbert, who wasn’t.

WORLDWIDE

Any photographer can find wild behavior to shoot at Mardi Gras. **Tyrone Turner** found wildlife—or people dressed like it. “These are the Krewe of Crawfish,” Tyrone explains of his spicy red companions (right), one of many parade clubs that convene during the annual festivities. “They’re friends with the Krewe of Nefarious Nutria, a sort of muskrat. I saw a few wetlands-related groups marching,” he says, “including the Krewe of

Coastal Erosion.” What costumes did that group wear? “One guy dressed as an oil rig.”

Tyrone, a New Orleans native, shot much of the story around Louisiana’s bayous “in places I’d never been before.” There he was persuaded to try new foods. “I never had the chance to try nutria,” he says, “but the garfish was good.”

“Modern-day Lebanese are a lot like the Phoenicians,” says photographer **Robert Clark**, “a real cultural mix. Everybody seems to speak Arabic, French, some Italian, English, a little Hebrew. It’s a very cosmopolitan place.”

Rob noticed that Lebanon’s cross-roads status has had another effect. “Maybe because so many kinds of people have passed through over the centuries,” he says, “Lebanese—men and women—are extremely good-looking.”



WEBSITE EXCLUSIVE Find more stories from our authors and photographers, including their best, worst, and quirkiest experiences, at nationalgeographic.com/magazine/0410.



JOSHUA BRANDON COATS (ALL)

ELKO, NEVADA

Shooting the Old-Fashioned Way

Some men get bright red convertibles during their midlife crises. **Robb Kendrick** got into old-fashioned photography.

The Texas-based photographer had actually been buying antique tintypes—images made from a complex 19th-century method (below)—since he was a teenager. Four years ago, at the age of 36,

he was feeling a little frustrated in his work. “I read this story about a guy in upstate New York who had given up everything to do tintypes. He lives in a cabin with no water or electricity and gets around in a buggy.” Robb found the man and learned how to make tintypes. “It’s definitely not easy,” he says.

Or fast. Each picture Robb shot in Elko (above) took as long as an hour to produce—using toxic chemicals and a thin iron plate—and if his subjects moved even a quarter of an inch during their ten-second poses, they were out of focus. Because tintypes must be processed as soon as they’re shot, Robb used a portable dark-room (right)—a three-foot-high box. “If it was 100°F outside, it was 110°F in there,” he says. For



him, at least, it seems once popular tintype photography is getting hot all over again.

WEBSITE EXCLUSIVE See how tintypes are painstakingly created in a video narrated by photographer Robb Kendrick at nationalgeographic.com/magazine/0410.



ELKO, NEVADA

Reflections on Tintypes

The story of tintype photography and *NATIONAL GEOGRAPHIC* is a short one: While pictures made with the process have occasionally been published in the magazine, none have been shot on assignment until the recent work of photographer **Robb Kendrick**. Robb's portraits in this issue capturing the cowboy character of Elko, Nevada, are, along with his portrait of archivist Bill Bonner (*Behind the Scenes*, May 2004), the first tintypes to earn a place in our Image Collection.

Invented by an Ohio chemistry and physics professor and patented in 1856, the tintype method actually involves no tin.



ANDREW DANEMAN COLLECTION (BOTH)

Instead, a thin plate of iron is painted black, then coated with a sticky collodion solution and bathed in a mix of sensitizing chemicals. The photographer makes the image by placing this wet plate into a holder in the camera and exposing it to the lighted subject for several seconds.

Developing must be done immediately. The photographer rushes to the darkroom to jiggle the plate in a bath of developer, then rinses it twice in water before dunking it in a potassium cyanide solution, which bleaches and fixes the image. Finally the image is dried and varnished to preserve it. From start to finish the process can take up to an hour—which, by 19th-century standards, was practically instant photography.

Tintypes made photography available to everyone. They were more affordable and durable than the earlier

daguerreotypes, which were made on sheets of silver or copper layered with fragile panes of glass. Tintype entrepreneurs set up shop in towns across America to shoot brides, babies, and men going off to war. Itinerant photographers—precursors to Robb, who hauled a portable darkroom to Elko and now pulls a tintype studio behind his pickup truck—traveled the country's back roads recording everyday life. Among surviving tintypes, stiff, formal portraits abound, as do relaxed family pictures (above) and posed scenes, like this female photographer (left) pretending to shoot two stuffy subjects.

So why didn't we assign any tintypes until now? Although tintype studios operated well into the 20th century, wet-plate processing was rendered obsolete with the advent of better dry-plate technology by 1887—a year before the founding of the National Geographic Society.

100 BEST VINTAGE PHOTOS

NGS has been collecting photographs for more than a century. Explore our archives at nationalgeographic.com/magazine/bestvintage.

Flashback



JAMES T. TANNER, NATIONAL AUDUBON SOCIETY

LOUISIANA WETLANDS

Feathers in His Cap

The population of the largest woodpecker in North America, the crow-size ivorybill, was already small by March 1938, when guide J. J. Kuhn and ornithologist James Tanner banded this baby in a Louisiana swamp. After jumping from its nest, the little ivorybill “climbed up Kuhn’s arm ... until it reached his shoulder ... and gave a few sharp taps on his cap. ... Upward it climbed until it was perched on the cap,” wrote Tanner, who returned it to its nest. Though Tanner sighted the same bird the next year, only a few more ivorybills were ever seen, anywhere. The last confirmed sighting was in 1971 in southern Louisiana. Most ornithologists now believe the ivorybill is no more. —Margaret G. Zackowitz

WEBSITE EXCLUSIVE

You can access the Flashback photo archives and send electronic greeting cards at nationalgeographic.com/magazine/0410.